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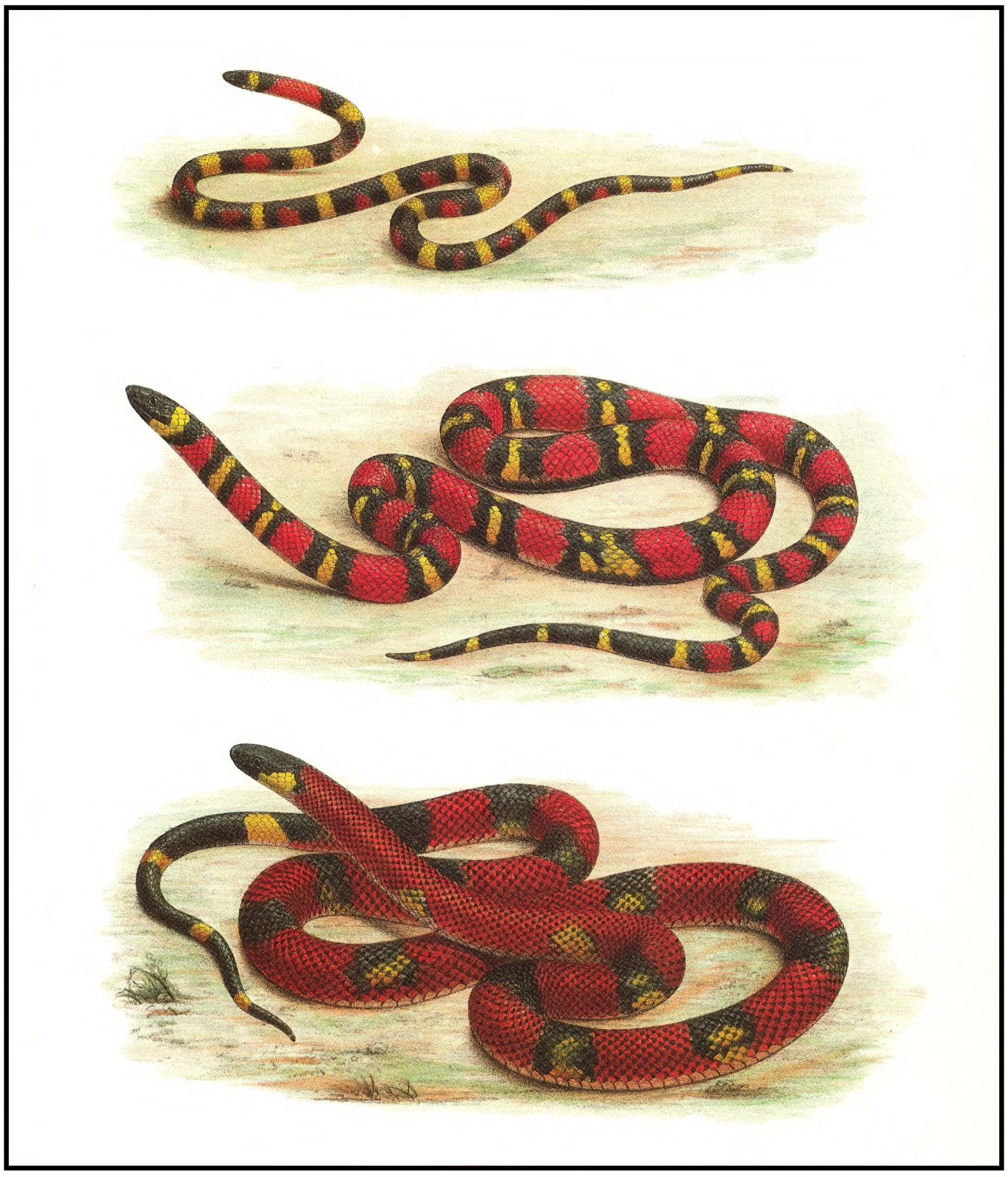

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Portrait of a Herpetologist as an Older Man—Chapter 4: Studying Chameleons

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Some of the vignettes in this article have been published elsewhere, but are included again here to produce continuity.

Introduction

There have been two groups of lizards that have held my interest from the beginning: chameleons and monitors. The latter group, especially the Komodo Dragon, I will cover in my next chapter. Here I will touch on my involvement with chameleons, including images of some of my favorite chameleon structures / ornaments from the literature.

A few amusing stories to start your day

During college years whenever I visited Jim Langhammer in Detroit, Michigan, we always tried to get together with three of our favorite raconteurs: Bill Austin, curator of herpetology at Detroit Zoo; Don Hunt, owner of *Bwana Don's Animal Exchange*; and George Campbell from Grosse Pointe, vice president of overseas operations at the Parke-Davis drug firm. While all three are gone now, I will highlight stories from each so you can form an accurate picture.

Bill Austin was in his herp office one day when the zoo office called asking if he could help a young girl who had called and said that her beloved pet hamster was lying on its side in its enclosure, wheezing and breathing heavily, trembling, and was near death. Bill said the mammal should be euthanized for humane reasons. She burst into tears and mumbled haltingly, asking if Bill would do it for her at the zoo. Bill, ever sensitive to tragedy, agreed to do so. She came into his office, weeping profusely, holding a beautiful ebony box with red satin lining, probably used earlier to hold rare jewels. Bill reached into the box, grabbed the mammal by the hind limbs, smashed its head against the corner of his desk so it was reflexively kicking and said now it has a beautiful coffin. She screamed a heart-stopping primal noise and ran from the room, leaving the box behind. I told Bill that the city should send him to charm school for sensitivity training. He laughed, saying that slamming food mammals had been his method to dispatch them during his entire career, and he had thrown the hamster into a snake cage for disposal.

Don Hunt started *Bwana Don's Pet Shop* in Ferndale, Michigan, and *International Animal Exchange* (IAE) that supplied a number of animals for zoos as well as private customers. He was well known in the area, wearing safari garb, for a popular TV program using live animals as props. He had an enormous number of contacts in the animal business. He told us about his time in Africa, collecting Goliath Frogs (*Conraua goliath*) in Cameroon for sale to zoos—not an easy business. The two dozen anurans were sent to the drive-through animal park outside Dallas (IAE). John Mehrtens at the Fort Worth Zoo bought several and placed them in a large enclosure with hanging soft plastic sheets on all walls to prevent injury. It did not work.

Since they are the largest frog in the world, over a foot in body length, they are tremendous leapers—often injuring themselves in captivity. I have seen two methods for successful maintenance: (1) a small aquarium at Antwerp Zoo barely containing the anuran; (2) an enormous semi-aquatic crocodilian-sized enclosure with the large pool in front at Brookfield Zoo in Chicago.

Later, another venture was a drive-through animal park near Dallas with Don and his brother Brian. There were several large lakes on the property and one included a paddock housing a group of giraffes. When my son James was a dozen years of age, we were allowed to go fishing there. On one occasion, he hooked a rather impressive gar and the struggle began. In the middle of the bout, an adult giraffe stood over him, splayed its front legs, and lowered its neck over him to drink, so both worked to land the fish together for 15 minutes—quite a sight. We became nervous though when the beast moved to the car and started licking the windshield, pulling the wipers with its mouth and stepped on the fishing rod, breaking it in the middle. It was time to leave.

George Campbell was executive vice-president in charge of overseas drug sales for Parke-Davis drug company that offered him an opportunity to travel the world. He lived in a mansion in Grosse Pointe, Michigan, and invited us to visit his menagerie. I never saw it saw it myself but I was warned that sometimes he would meet guests in the spacious front yard acting like Tarzan by yodeling, wearing brief shorts, no shirt or shoes, and whipping guests with a long camel whip.

In his menagerie a five-gallon jug with a tiny spout held an adult snapping turtle, placed at hatching like a ship in a bottle. In his capacity as an international traveler, he would stuff animals into socks in his luggage. Thus, George was able to build a collection of small crocodilians (most species) under 6 feet and multitudes of chelonians. For his numerous small birds, the cages were permanently stapled to the top corners of each room; bird defecations and uneaten food would drop to the floor. To clean all of these creatures, he flooded the floor, wore hip boots and put in some plugs, causing the water to rise to his waist.

He owned a so-called tame adult African male mandrill, a large colorful primate. In spite of George's protestations to the contrary, it was an intimidating animal. I was constantly nervous as it strolled around the large living room or solicited sexual favors as it displayed to female guests. In one case, it ejaculated down the back of a VIP guest's wife.

Are mandrills dangerous? The answer is yes. When this monkey felt unsafe, he would turn aggressive. Sometimes, when George was in his hammock, it would open its mouth and place its canines on either side of George's neck; George remained motionless for many minutes, and said that it was a test of dominance he always won.

The mandrill has a bald face with an elongated muzzle with the characteristic features of red, bluish, green and shades of yellow. George owned a sports car convertible and so he would put a yachting cap on the primate after it was in the passenger seat and buckled in for a drive through Detroit. George told the story that a driver in the adjacent car saw the monkey, accidentally hit the accelerator, sent his car through a grocery store plate glass window. The perpetrator and companion promptly left the scene and neither was ever arrested.

When he retired to Florida, he sold his crocodilian collection to Ross Allen. Read his autobiographical book, *Jaws Too*.

Studies on several chamaeleon taxa

Many years ago, a female Jackson's chameleon (*Trioceros j. jacksonii)* gave birth at Dallas Zoo, so I invited Professor Gary W. Ferguson and his biology class at Texas Christian University in Fort Worth, Texas, to see the little critters up front and personal. The lizards were being kept in a large screened enclosure outdoors. Gary had never seen living ones so he dropped to his knees transfixed and immobile for many minutes soaking up their essence. A chameleonophile was born! What was particularly endearing was watching a young lizard practicing the extension of the tongue to secure prey. When missing the target the tongue would stick to the cage so the reptile would walk forward and "reel in" the tongue, much like fly fisherman walking to a stuck lure in a branch.

Because these highly territorial lizards are incompatible, a number of large *Ficus* trees were placed on the floor of a Jackson's chameleon exhibit—each with a single chameleon—and encircled with a sheet metal barrier at the base to keep the lizards separated.. Daily feeding demonstrations were held and were exceedingly popular with visitors. Occasionally, sarcophagid fly larvae would be missed by the chameleons and would escape into the flower pots whereupon these insects hatched in the exhibit and were later plucked off by the lizards. One day, a fly landed on the inside of the glass at an adult human's eye level and a visitor witnessed the chameleon tongue up front and personal. She emitted a scream rivaling the decibel level of a jet plane and fell backwards into the crowd, taking a few small children to the floor with her.

On rare occasions, a male lizard would escape outside the barrier and travel to the highest possible point in the enclosure (30 ft). We released another male that immediately chased the escapee at the highest possible "chameleon speed" until the end of the exhibit was reached. Without hesitation, the subdominant lizard released its grip and dropped outside the exhibit without injury, and then hightailed it on the floor to the far end of the building.

In 1982 Gary Ferguson, Rick Hudson from Fort Worth Zoo, and I traveled to Kenya to collect specimens for Texas zoos and preserve a series of Jackson's chameleons for a description of what was to become a new taxon: now *Triceros jacksonii xantholophus* Eason, Ferguson, Hebrard 1988 (see Ferguson et al., 1991). We also examined *Kinyongia boehmei*, *Chamaeleo dilepis* and *Chamaeleo gracilis*.

Our host was Jim Hebrard, a faculty member at University of Nairobi, who also invited Edmund D. "Butch" Brodie, Ron Nussbaum, Tom Madsen, Ken Dodd, and the three of us to bunk out in his apartment, which then became mindful of a homeless shelter. Butch and Ron studied caecilians, and Tom had just finished a splendid documentary for Swedish television on predator / prey relationships of the Water Cobra (*Boulengerina* [now *Naja*] *annulata*) and shell-dwelling cichlids (*Lamprologus*) in Lake Tanganyika.

Our sponsor was Alex Duff-MacKay from the Nairobi Natural History Museum and Zoo, who arranged logistical elements, travel and permits. When we went to the Zoo, a keeper dumped a large number of chameleons into the Boomslang yard as food, and the lizards were set upon immediately. This snake, a rear-fanged highly venomous species capable of causing human deaths, immediately began vigorous chewing but these saurians struggled for a surprising lengthy time—could they be partially immune?

Many Kenyans view chameleons with mixed feelings, in large part due to their unusual morphology and belief that they are highly poisonous if their sharp claws pierce the skin. We offered to pay local people to collect them, but their responses were unpredictable—certain death from disease or poison versus extra money! I only saw one man hold a captive by hand; all other collectors brought them to us holding onto long branches (often longer than 10 feet). We let the lizards crawl up on our bodies and clothes. Women and children loudly screamed and ran into the bush and men backed off out of range. Gaining courage, they slowly returned for the money.

Gary purchased some metal tree-climbing gear, hoping to reach the tips of the canopy to secure that special out-of-reach chameleon, but the maiden voyage did not go well. After figuring out all of the intricacies of the lines, belts, spikes and so on, Gary certainly was remindful of the famous Paul Bunyan image—the only missing features were the heavy wool plaid shirt and heavy-duty roughneck double-bit axe. Gary gained a few yards up the tree only to fall in a heap of metal at the base—the first and final voyage!

The best way to collect chameleons is at night using flashlights, as they lose their striking colors and turn pale and whitish against vegetation. On our first attempt that was admittedly terrifying. Tree hyraxes began screaming like barfing chickens, a magnificent yet horrifying sound indeed. Large mega-mammals crashed through the bush, a leopard ran in front of us, lions began roaring, and it began to dawn on me that Africa was the first collecting site I had been to where we could be killed by animals. The next day, we drove out to the camping ground at Amboseli to see if we might consider sleeping there overnight. A flat-bed truck was being used by solders to transport a dead body to Nairobi to be autopsied. I asked a shaken couple what had happened. A drunken man was out of his tent in the night, singing and yelling, and was attacked by lions. This poor couple heard his screams for help for many minutes but were afraid to leave their tent. The woman was so shaken that she insisted that they return home to Sweden immediately. No tent dwelling for us; a banda inn [hotel] would do nicely. Bandas are found throughout Kenya, available for a nominal rental price. They have fireplaces and the women make a modest living selling

firewood to tourists as evenings are sometimes quite cool. One evening after a long day collecting, we sat on the patio at night, having a drink and enjoying a starry night. After a few hours, we turned on a flashlight to get some ice inside and about a half-dozen spotted hyenas stared at us from a few yards away. We slowly shuffled back inside and the other mammals remained outside—no telling what their intentions were, but becoming a meal was possible.

In Amboseli, we rented a car and watched four lionesses and six half-grown cubs resting in a small patch of grass. In the distance, several hundred wildebeest, walking slowly and bleating, approached the patch so the lions silently dropped down into the grass until all were camouflaged. Amazingly, although we knew that the carnivores were next to us, they were invisible. The lead antelope looked directly into the patch and snorted. All the rest turned as one and stared toward the lions that immediately stood up and sauntered off—the rapid signals given between predator and prey were impressive.

Butch and Ron had been studying *Kinyongia boehmei,* for which the IUCN Red List gives two alternative English common names: Taita Blade-horned Chameleon and Böhm's Two-horned Chameleon. They also studied the Taita African Caecilian (*Boulengerula taitana*). Both of these species are endemic to Kenya. They suggested that we travel to the Taita Hills where they had been hiring local collectors for some time. When we arrived, they asked questions about our intentions. They had a specialized hand-written price list using scientific names—sex, reproductive status, size and other pertinent data. We accepted their terms and off they went into the bush. They came back in an hour with handfuls of both species so we had our pick. When we said that our needs had been fulfilled, the collectors insisted that we purchase all animals and blocked our departure as we moved slowly away. Gary was driving so they threw dozens of animals on top of him through the open window as he was trying to escape—we released all extra herps when out of sight.

Gary was working on a paper describing a new subspecies, the Mt. Kenya Jackson's Chameleon (now *Trioceros jacksonii xantholophus*). So we visited Don Hunt at Mt. Kenya, who kindly allowed us free lodging, delicious meals, and a totally tame cheetah as a dinner companion. Don invited us to go on several collecting trips for large mammals: rhino, giraffe, eland, and several antelope taxa. Since I am allergic to anything organic, an added benefit was to have access to antihistamine drugs, cortisone and epinephrine from Don's vet.

A Trip to Madagascar to study the Panther Chameleon

The purpose of Gary's and my book, *The Panther Chameleon: Color Variation, Natural History, Conservation, and Captive Management*, was to review the natural history and conservation of the Panther Chameleon on Madagascar and nearby islands in the Indian Ocean. Color variation of male interactions were examined from Nosy Be, Ambanja, Diego Suarez, Sambava, Tamatave, Maronantsetra, Ankaram, Île Ste. Marie, Île Reunion, and Fenerive. Overnight accommodations in all places were alike—no screens on windows to keep out biting insects, no indoor shower or plumbing, just a bucket without toilet tissue!

One chapter of the book includes collecting and exportation. Although we had received a scientific permit in Texas, additional signed approvals to obtain scientific permits were covered by three different agencies in Antananarivo, all of which were in conflict with each other. A regular collapse of telephone service forced us to hire taxis to go personally to each agency, only to learn that often the proper signatory was on vacation and no other official could sign the document. Piles of unsigned permits covered the floor of each agency—I saw *no* file cabinet in Madagascar! The whole process postponed our study for slightly over a week, resulting in increased cost. Ironically, had we wanted to export these lizards for sale, an export permit could be purchased and issued in a few days. The species that are allowed currently for sale are Oustalet's Chameleon (*Furcifer oustaleti*), Warty Chameleon (*F. verrucosus*), Carpet Chameleon (*F. lateralis*), and Panther Chameleon (*F. pardalis*).

When we arrived at in-country customs, we had to declare and show all of our money to the agents as the concern was money laundering. The only way to change to Malagasy currency was to use approved exchanges that later proved to be a significant problem because transfer receipts were required to be shown upon departure. Independence Day in Madagascar is June 26, an annual national holiday which commemorates the country's final shaking of colonial rule. It is celebrated all across the archipelago with feasting, drinking, music, and dance. The time span for this celebration usually lasts a week during which all money exchanges are closed. Since credit cards were not used in Madagascar, the country totally stops any financial transactions and we were desperate to find any monies to pay expenses for a week. A benevolent hotel owner covered our costs until the country awakened for business.

Some of the chameleons that we encountered were temporarily collected and held briefly to introduce to another free-living lizard to elicit postures and color changes during ensuing social encounters. Color photos of the encounters were used to perform color analyzes to explore differences or similarities throughout the range.

One evening, Gary and I examined a global list of chameleons to determine this group's future conservation status. We projected that common taxa like Veiled, Oustalet's, Panther, Warty, Carpet, Jackson's and other weedy species that adjust well to captivity likely have a stable future, whereas those from forested habitats are in trouble. As an example, we saw bare remnants of primary forest in Madagascar, mostly along the banks of rivers and streams, and populations of species in these places were smaller. This was not a detailed scientific study but rather based on our observations in the field, discussions with colleagues, and literature. We concluded, much to our horror, that probably two-thirds were at serious risk of extinction throughout the world and these were mostly taxa that lived in primary forest or fragile areas modified by humans.

Why do some chameleons do poorly in captivity? Here is a hint from a section in one of my earlier papers: "A new challenge is the recent study by Karsten and associates which explains why some imported animals could probably never have been successfully kept in captivity for extended periods. They found that Labord's Chameleon (*Furcifer labordi*), from arid

Figure 1. Gamaleon [chameleon] from a body of works called *Hortus sanitatis* [Garden of Health] that appeared not after 21 October 1497. The following quote is from the text of an early English version: "a beste with ii wynges and four fete havinge an hede lyke an adder and a longe wronge tayle lyke a dragon and bereth gere [hair?] on his backe lyke woll and the clothe that therof is made can nat burne." Courtesy of Smithsonian Institution Libraries, Washington, D.C.

southwestern Madagascar, is an 'annual' lizard living mostly as an egg for about nine months and then only four or five months outside the egg. These lizards reach sexual maturity in two months. This may mean that the brief life span of chameleons in captivity might, for some species, actually represent the natural adult life span. So questions are asked and suggestions given by the authors in their abstract: 'Consequently, a new appraisal may be warranted concerning the viability of chameleon breeding programs, which could have special significance for species of conservation concern. Additionally, because *F. labordi* is closely related to other perennial species, this chameleon group may prove also to be especially well suited for comparative studies that focus on life history evolution and the ecological, genetic, and/or hormonal determinants of aging, longevity, and senescence'" (Murphy, 2009: p. 141).

Chameleons: Johann von Fischer and other perspectives

Quoting from Murphy (2005): "European chameleons are delicate captives and multi-generations are uncommon even today (Nečas, 1999). Hence, it is remarkable that Johann von Fischer kept colonies in Vienna in 1882 and made detailed observations on capture, transport, husbandry, behavior, coloration, and reproductive biology. His studies have been largely unavailable to English readers . . . " Those studies (Fischer, 1882) were translated by Lucian Heichler in Murphy (2005). Fischer's 120-year-old examination was written in remarkably

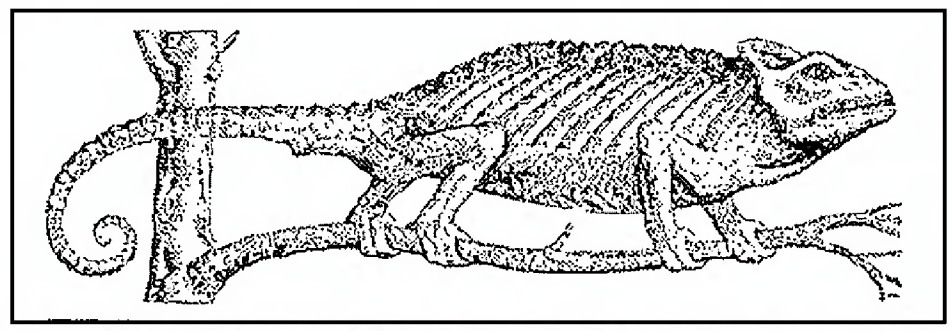

Figure 2. Illustration from Konrad Gesner (= Conrad Gessner) in 1563. [*Animal Atlas: a brief description of all quadrupeds living on dry land and in water, together with their correct depiction. First described in Latin by D. Cunrat Gessner, but now also translated into German and arranged in a brief, proper order by D. Cunrat Forer*.] From the collections of the Ernst Mayr Library, Museum of Comparative Zoology, Harvard University.

archaic German—with spellings that have not been used in many decades. Clearly, he was concerned about the humane treatment of chameleons and passionately pleads for proper care during capture and transport.

The European chameleon studied by Fischer is found in the Sinai Peninsula (*Chamaeleo chamaeleon musae*), Arabia (*C. c. orientalis*), eastern Mediterranean region (*C. c. recticrista*), and northern Africa and southwest Europe (*C. c. chamaeleon*). Nečas (1999) described the climate and habitat. Elevations range from sea level to as high as 2600 m. The lizard is found in semi-deserts in association with eucalyptus, tamarisk bushes, acacias, and grassy savannahs. Temperatures range from –5° to 40°C with as much as a 20°C daily fluctuation. Annual precipitation ranges between 400 and 800 mm and relative humidity from 13 to 80%.

European chameleons are under siege, due primarily to habitat destruction (as an example see photograph by L. Lee Grismer in Pianka and Vitt [2003: p. 254]) and overcollecting. In the early 1990s, I saw thousands of lifeless, dried, common chameleons strung together and offered for sale in Kasbahs throughout Morocco. Averaging 30–40 lizards per strand, the chameleons were hung from hooks affixed to walls and ceilings in these shops. The proprietors said that they were being sold for medicinal purposes and they claimed that ingestion of chameleons was an effective remedy in curing diseases. When asked what diseases were cured with chameleons, no shopkeeper could identify a specific ailment successfully treated, although a few added that regular consumption of chameleons could restore sexual vigor.

How to Draw a Chameleon

Early illustrators and naturalists during the 15th and 16th centuries were often at a loss to produce lifelike representations of chameleons. In 1497, a woodcut showing a "gamaleon" was published in a body of works called *Hortus sanitatus* [Garden of Health], but the creature looks more like a canine with wings than a chameleon (Figure 1). Chameleons do not look or act like other lizards—rotating eye turrets, zygodactyl feet, extensible prey-catching tongues, prehensile tails, elaborate ornamentation, and rapid color changes—so it is not surprising that these artists were bewildered. The common chameleon, due to availability, was often the subject of European authors and artists.

Shown here are further examples of early artistic renderings (Figures 2–16).

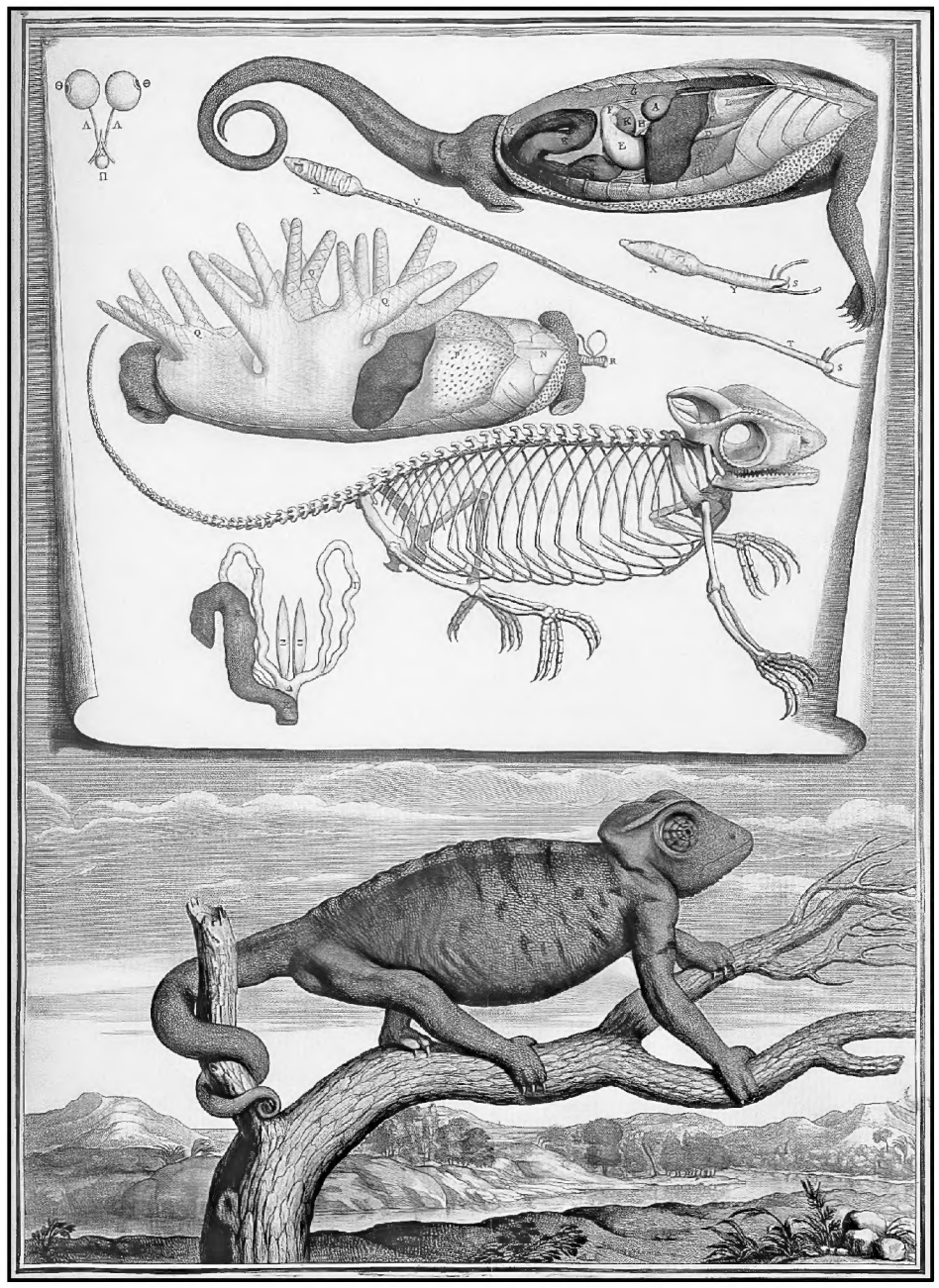

Figure 3. Illustration of chameleon from *Mémoires pour servir à l'histoire naturelle des animaux . . .* by Claude Perrault in 1676. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

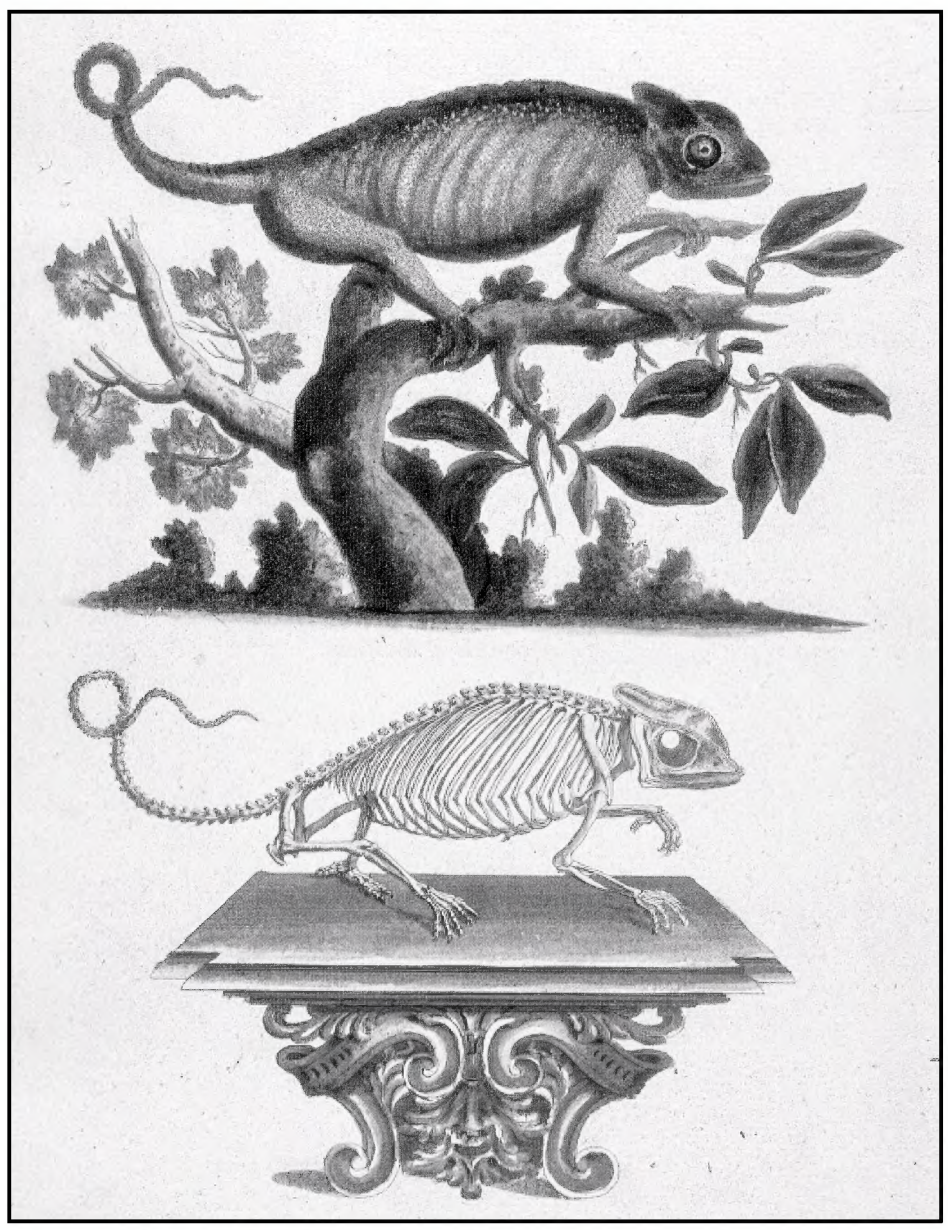

Figure 5. Illustration of chameleon from *Angenehmer und nützlicher Zeit-Vertreib mit Betrachtung curioser Vorstellungen Allerhand Kriechender . . . Thiere* by Daniel Meyer in 1748-1756. Courtesy of Kraig Adler.

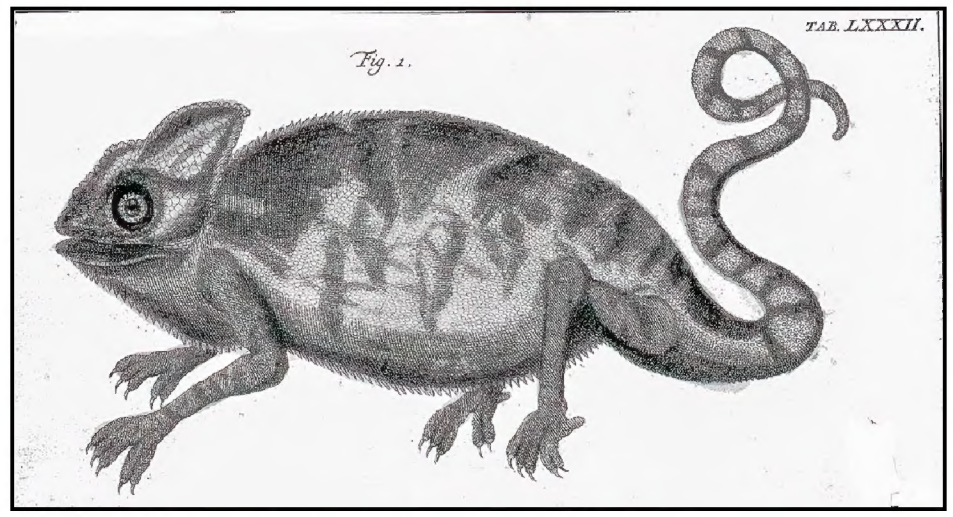

Figure 4. Illustration of chameleon from *Locupletissimi rerum naturalium thesauri* by Albertus Seba in 1734–1765. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

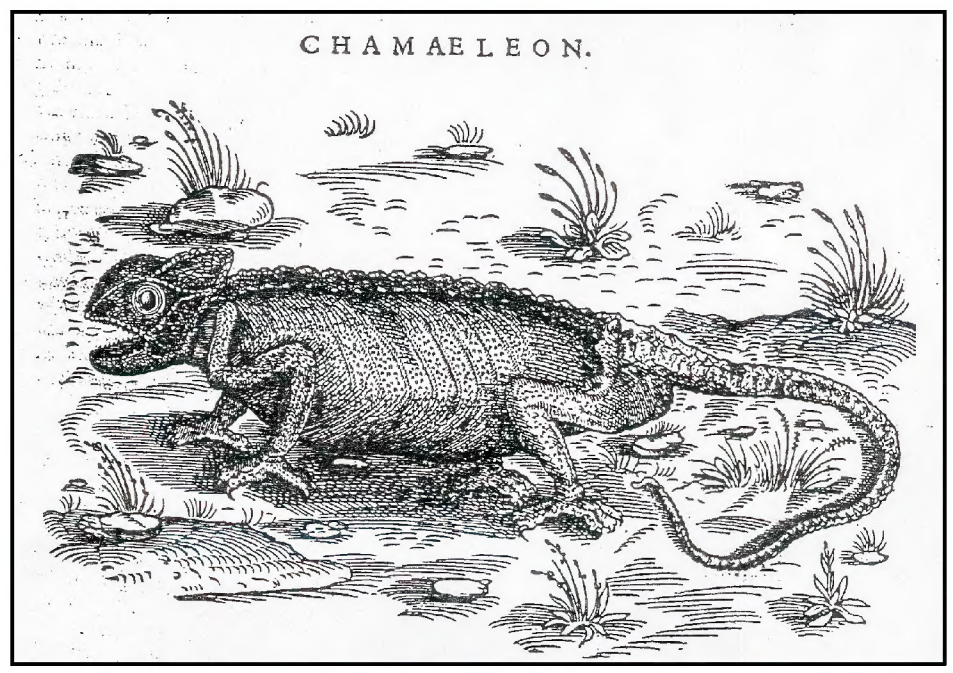

Figure 6. Illustration of chameleon in *Senensis medici, Commentarii in sex libros Pedacii Dioscoridis Anazarbei De medica materia / / iam denuo ab ipso autore recogniti, et locis plus mille aucti ; adiectis magnis, ac nouis plantarum, ac animalium iconibus, supra priores editiones longè pluribus, ad uiuum delineatis ; accesserunt quoque ad margines Græci contextus quàm plurimi, ex antiquissimis codicibus desumpti, qui Dioscoridis ipsius deprauatam lectionem restituunt ; Cum locupletissimis indicbus . . .* by Petri Andreæ Matthioli in 1565. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Figure 7. Buc'hoz, P.-J., 1775–1781. Première (& Seconde) Centurie de plances. Paris. From the collections of the Botany Libraries of Harvard University.

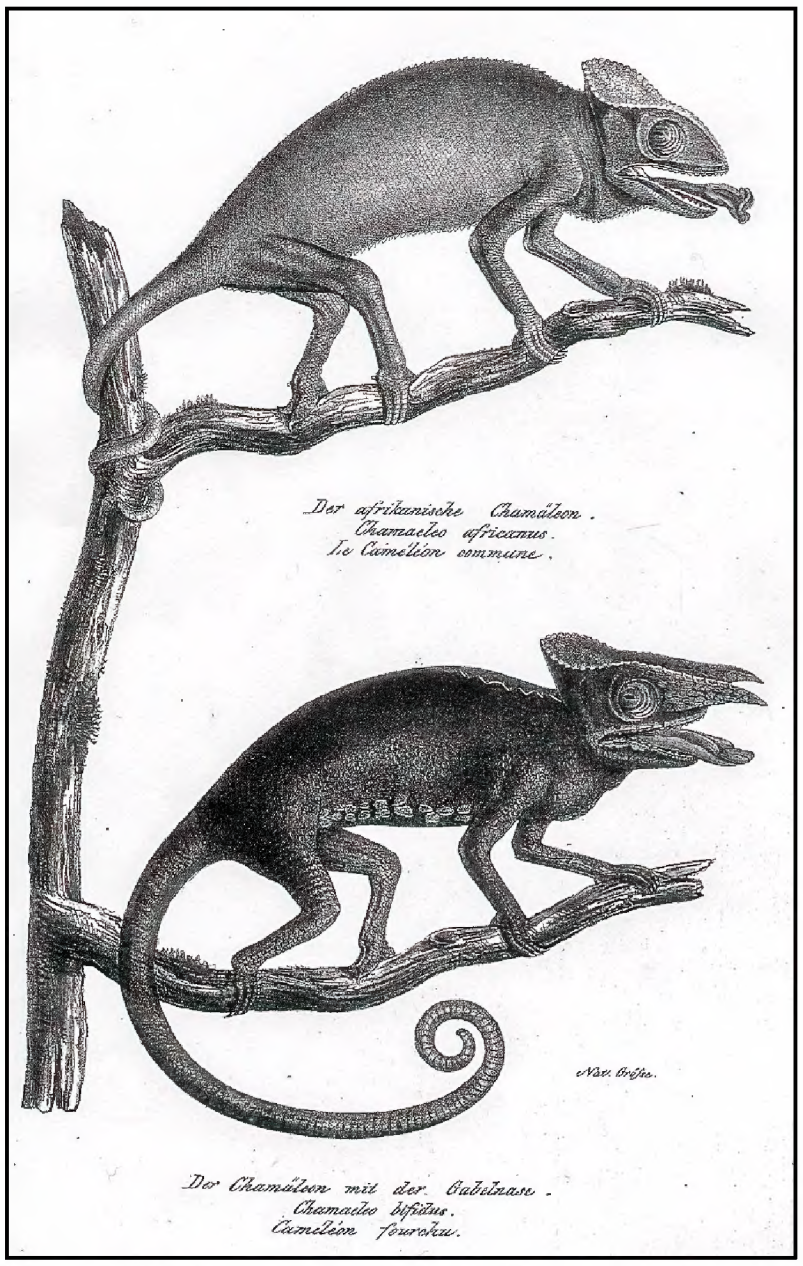

Figure 8. Illustrations of chameleons (*Chamaeleo africanus* and *C. bifidus*, both now *Furcifer*) from Heinrich Rudolf Schinz, *Naturgeschichte und Abbildungen der Reptilien* in 1833. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Figure 10. Illustration of chameleon from *Tableau encyclopédique et méthodique des trios règnes de la nature . . . Erpétologie. / Par m. l'abbé Bonnaterre . . .* by Abbé Pierre Joseph Bonnaterre in 1789. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

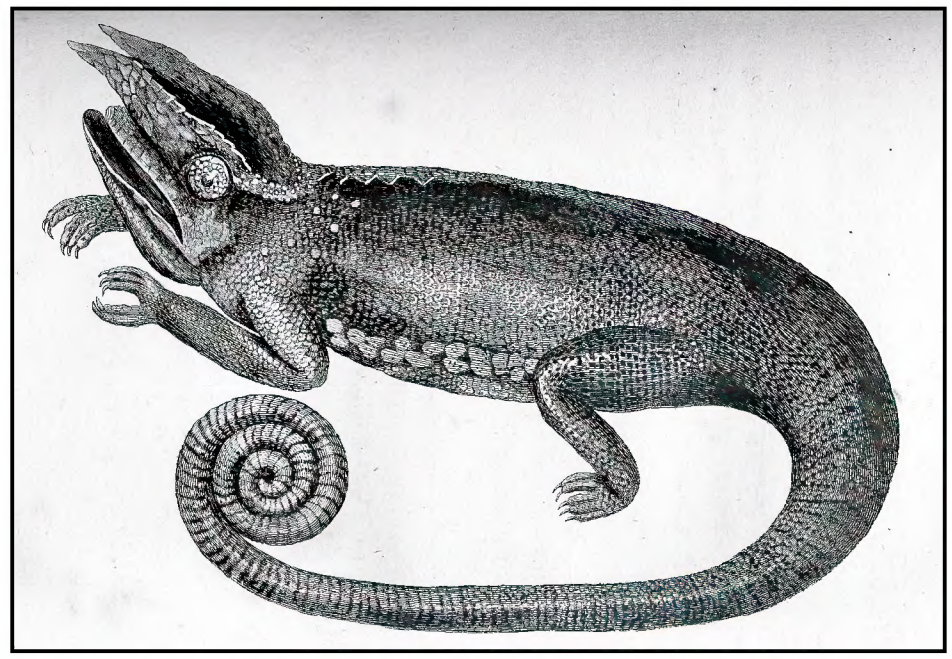

Figure 9. Illustration of Caméléon Nez-Fourchu (*Chamaeleo bifidus* or *fourchu*, now *Furcifer bifidus*) in *Histoire naturelle, générale et particulière, des reptiles; ouvrage faisant suite à l'Histoire naturelle générale et particulière, composée par Leclerc de Buffon, et rédigée par C. S. Sonnini. / Par F. M. Daudin* by François-Marie Daudin in 1802–1803. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

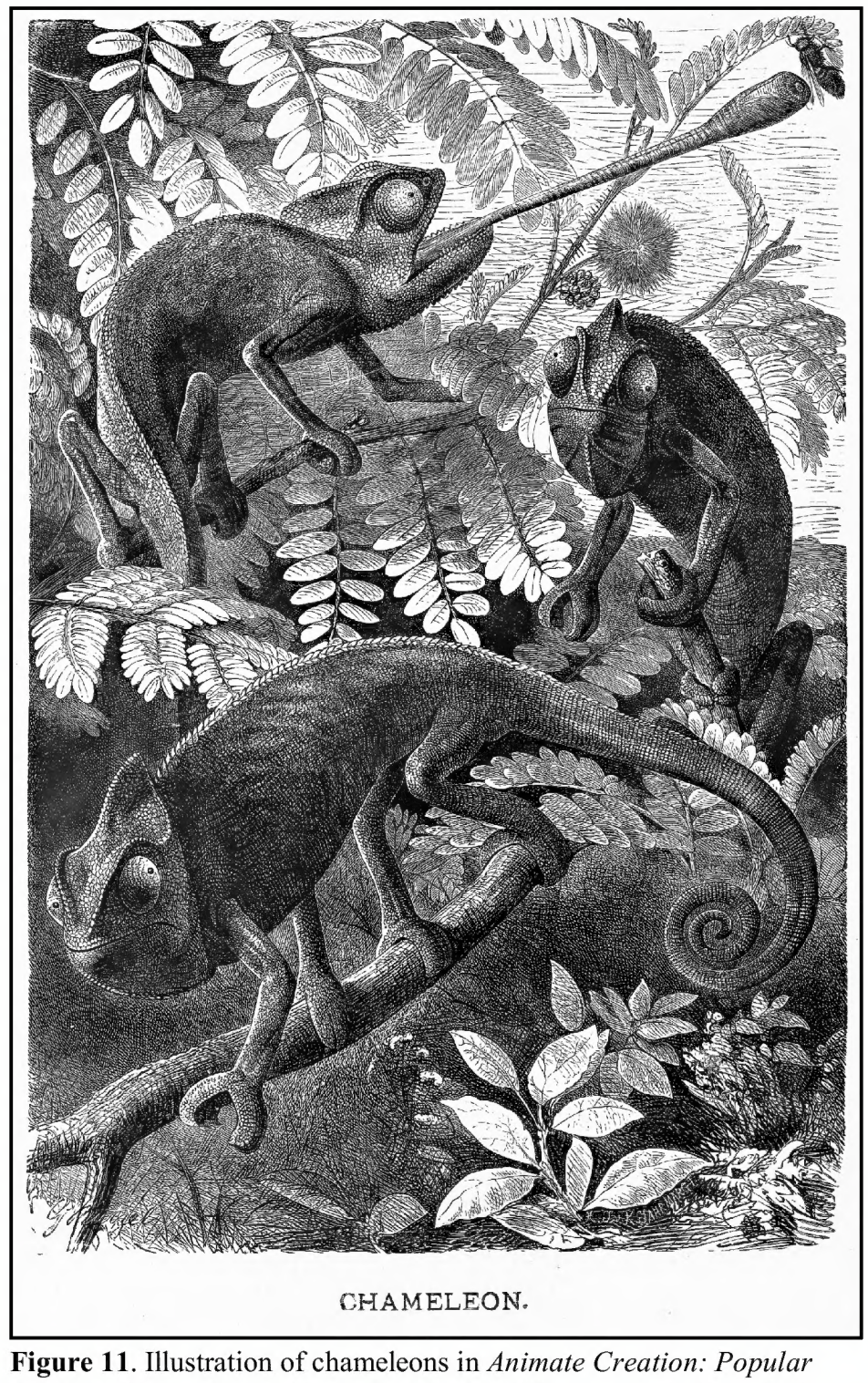

Figure 11. Illustration of chameleons in *Animate Creation: Popular Edition of "Our Living World," a Natural History, by the Rev. J. G. Wood. Revised and Adapted to American Zoology, by Joseph B. Holder* by J. G. Wood circa 1885. From the collections of the Ernst Mayr Library, Museum of Comparative Zoology, Harvard University.

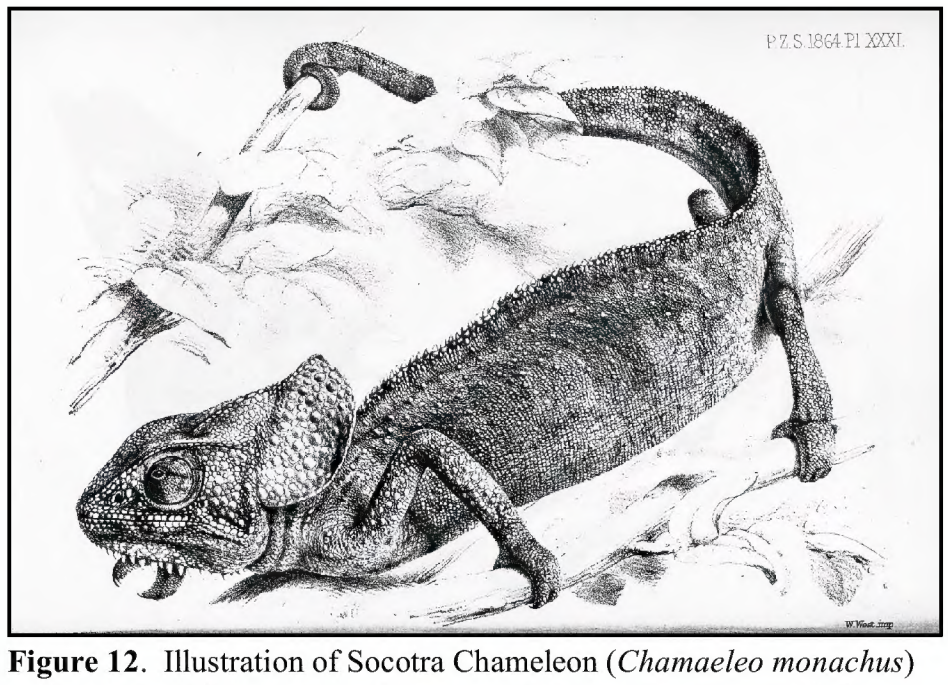

Figure 12. Illustration of Socotra Chameleon (*Chamaeleo monachus*) in *Revision of the genera and species of Chamaeleonidae, with the description of some new species* by John Edward Gray in 1865. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

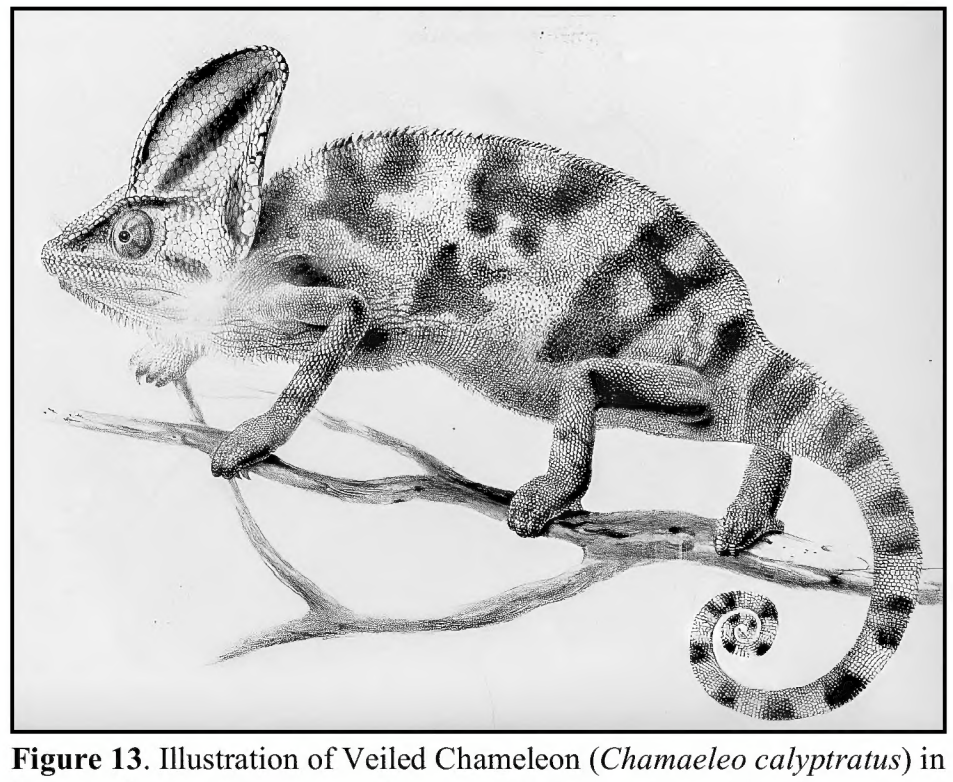

Figure 13. Illustration of Veiled Chameleon (*Chamaeleo calyptratus*) in John Anderson's *Zoology of Egypt* in 1898. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Figure 14. Cameroon Sailfin Chameleon (*Chamaeleon montium*, now *Chamaeleo montium*) in *Kunstformen der Natur* by Ernst Haeckel in 1903. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

Figure 15. Illustration by Lorenz Müller of chameleons from *Prodromus einer Monographie der Chamäleonten* by Franz Werner in 1902. Top to bottom: *Brookesia superciliaris*; *B. stumpffi*; *Chamaeleo* (*Furcifer*) *campani*; *C. melanocephalus*, now *Bradypodion melanocephalum*. Courtesy of Smithsonian Institution Libraries, Washington, D.C.

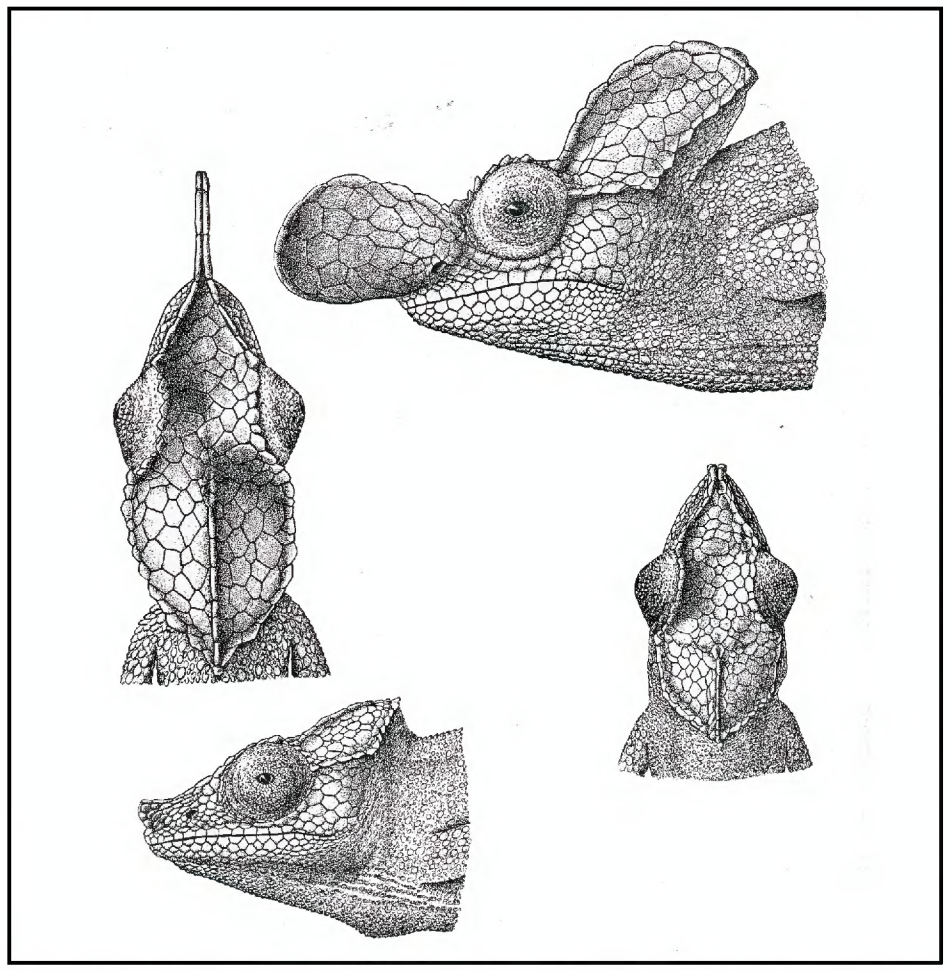

Figure 16. Strange-horned Chameleon (*Chamaeleo xenorhinus*, now *Kinyongia xenorhina*) from *Les caméléons de l'Afrique centrale : république démocratique du Congo, République du Rwanda et Royaume du Burundi* in 1965 by Gaston-François de Witte. Artists were Mme. Mertens and Mr. H. Dupond.

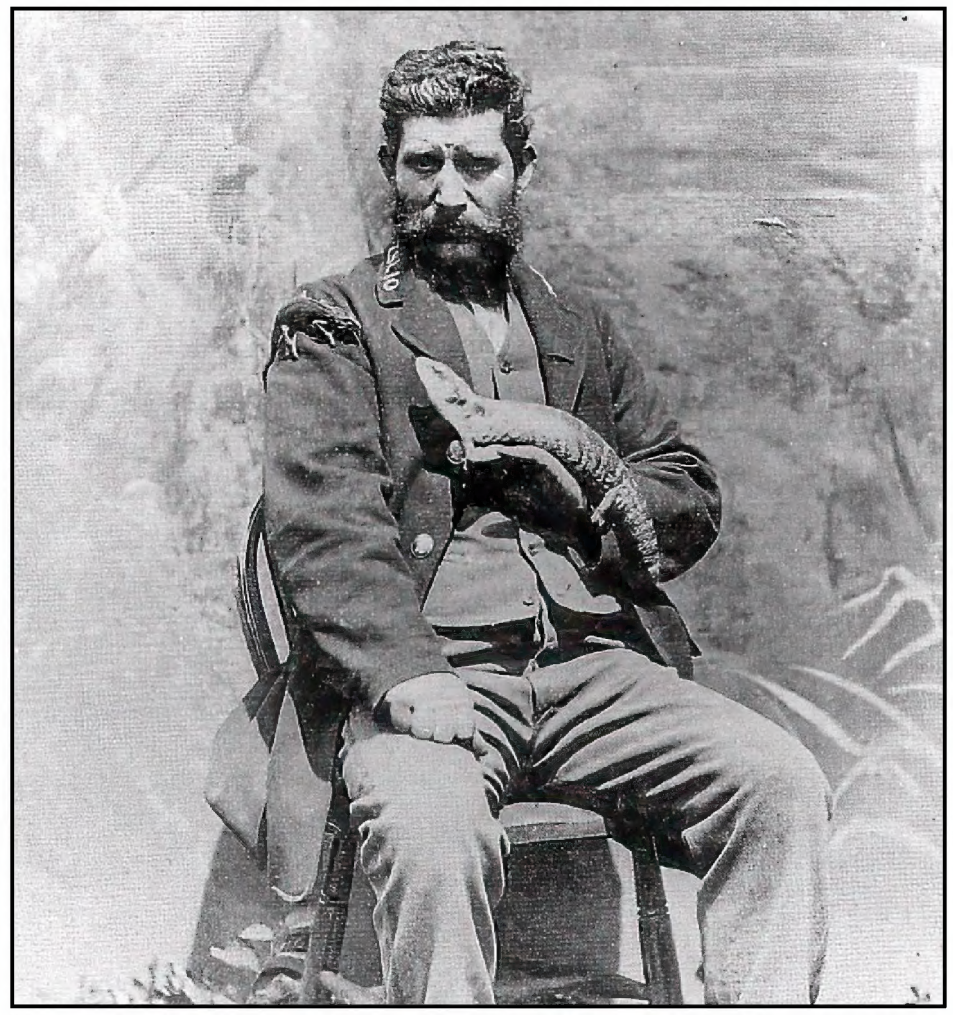

Figure 17. London Zoo keeper with chameleon on shoulder and blue-tongued skink (*Tiliqua gigas*) ca. 1872. Photograph by Frederick York, provided by John Edwards.

Acknowledgments

Gary W. Ferguson, professor of biology at Texas Christian University in Fort Worth, Texas USA, has increased our understanding of lizard biology through his many writings. His research on chameleons includes ecology, reproductive biology, social behavior, conservation and captive management. Judith Block, Gary Ferguson and Bill Lamar reviewed early drafts of this manuscript.

For various courtesies, I am indebted to Chris Raxworthy, Fran Woods, Nat Quansah, Warren Iliff, Ardi Abata, Lucien Heichler, John Endler, Falk Dathe, Wolf-Eberhard Engelmann, Ron Tremper, Ray Pawley, Trooper Walsh, Rick Hudson, Frank and Kate Slavens, Gerard Visser, Kevin Wright, and Scott Stahl.

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Bulletin of the Chicago Herpetological Society 56(12):225-228, 2021

Herpetological Art at the Saint Louis Zoo — October 2021

Photos and story by
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The first weekend in October of 2021 I visited my in-laws who live near St. Louis, Missouri, and took the opportunity to visit the St. Louis Zoo.

Near the zoo's front entrance, coiled on some large rocks, is a bronze statue of a cobra (Figure 1) with a plaque nearby identifying the statue as a Cape Cobra (*Naja nivea*). This statue is approximately three feet tall and shows the cobra reared up with its hood spread.

Figure 1.

To the northwest of the north entrance to the zoo is the Wetterau Pavilion with the Living World building that has exhibits and a gift shop. Above the south entrance to the Living World up near the roof is the head of a Jackson's Chameleon, *Trioceros jacksonii*, (Figure 2). Above the north entrance up near the roof is the head of what looks like one of the Asian horned frogs of the genus *Megophrys* (Figure 3). Two other parts of the building feature the heads of a barn owl and a mandrill. The heads of these four images are much larger than life-size and are probably made of concrete.

Near the Herpetarium is a post with an image of a cobra reared up with its hood spread out (Figure 4). There are also images of a monkey and two different kinds of birds. These images are placed in such a way as to direct the public to the areas of the zoo where those types of animals can be found. The images are metal plates, and from the green patina my guess is that they are made of copper and have been exposed to the weather for many years. Near these displays is a plaque that, in part, reads "In the 1920s the Primate House, the Bird House and the Herpetarium were built on Historic Hill in Spanish style architecture, with elaborate architectural details and open atriums filled with tropical plants."

Right in front of the Herpetarium is a bronze statue of a man holding a large snake that probably represents some kind of python (Figure 5). Many years ago, there was a plaque near this statue identifying this man as Richard Marlin Perkins. The plaque was missing during my recent visit. Marlin Perkins was best known for his nature TV show *Wild Kingdom*. His career included terms as director of the Buffalo Zoological Park in Buffalo, New York; Lincoln Park Zoo in Chicago, Illinois; and the St. Louis Zoo in St. Louis, Missouri. In the *Wild Kingdom* episodes Marlin and his companion, Jim Fowler, traveled around the world filming their adventures with the wildlife found where they were visiting.

Near Marlin Perkins's statue are large rocks that have images of a crocodilian, a turtle and several snakes engraved or carved into them (Figures 6 and 7).

There are two entrances into the Herpetarium and on both sides of the doors and right above each door are images showing frogs, turtles, crocodilians, lizards, and snakes (Figure 8). I can't imagine that any of these images represent any real species, except for a couple that show a lizard with a frill around its neck that probably represents the Australian Frilled Lizard (*Chlamydosaurus kingii*). These images are probably made of concrete.

Figure 2.

Figure 3.

Figure 4.

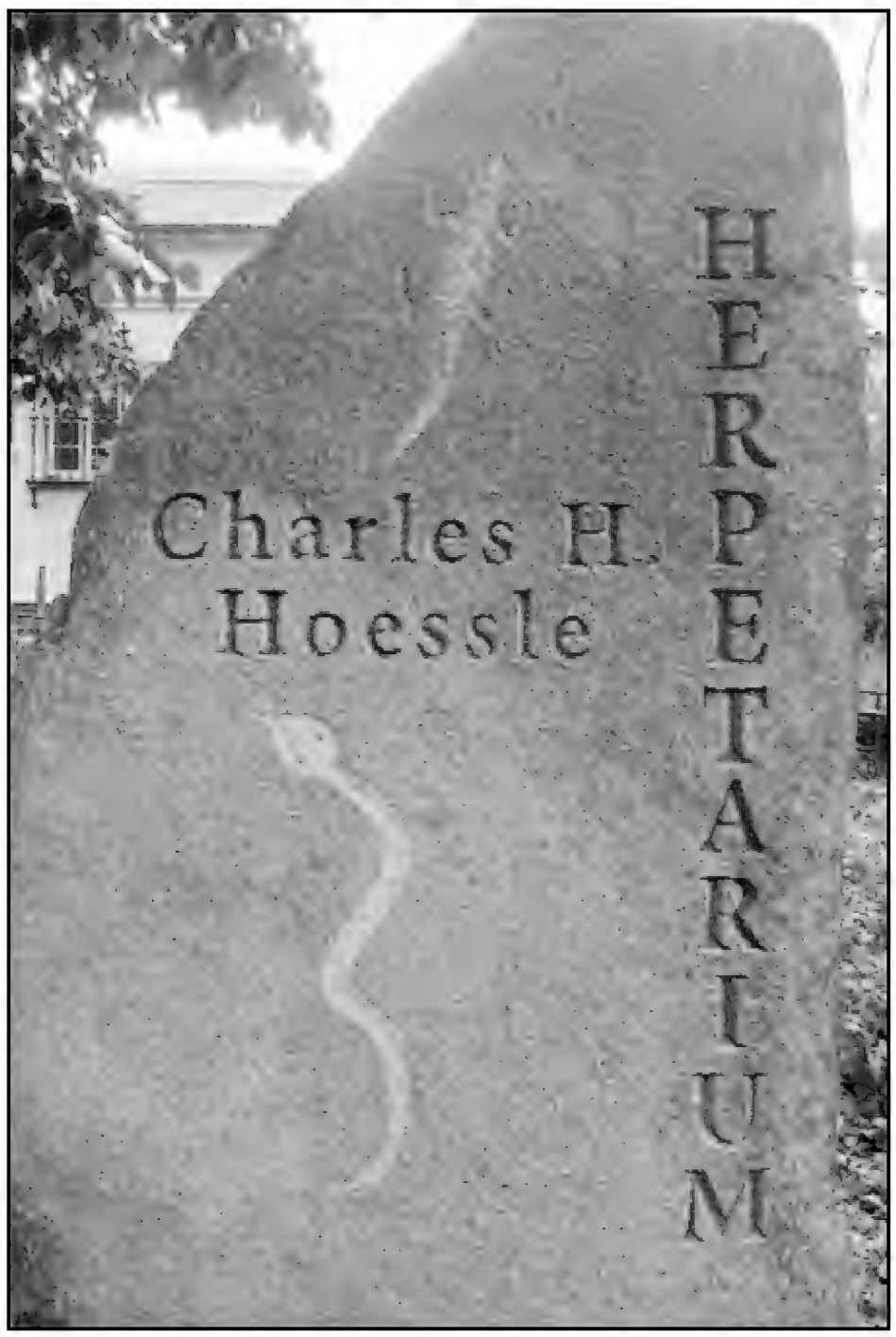

Figure 6.

Figure 5.

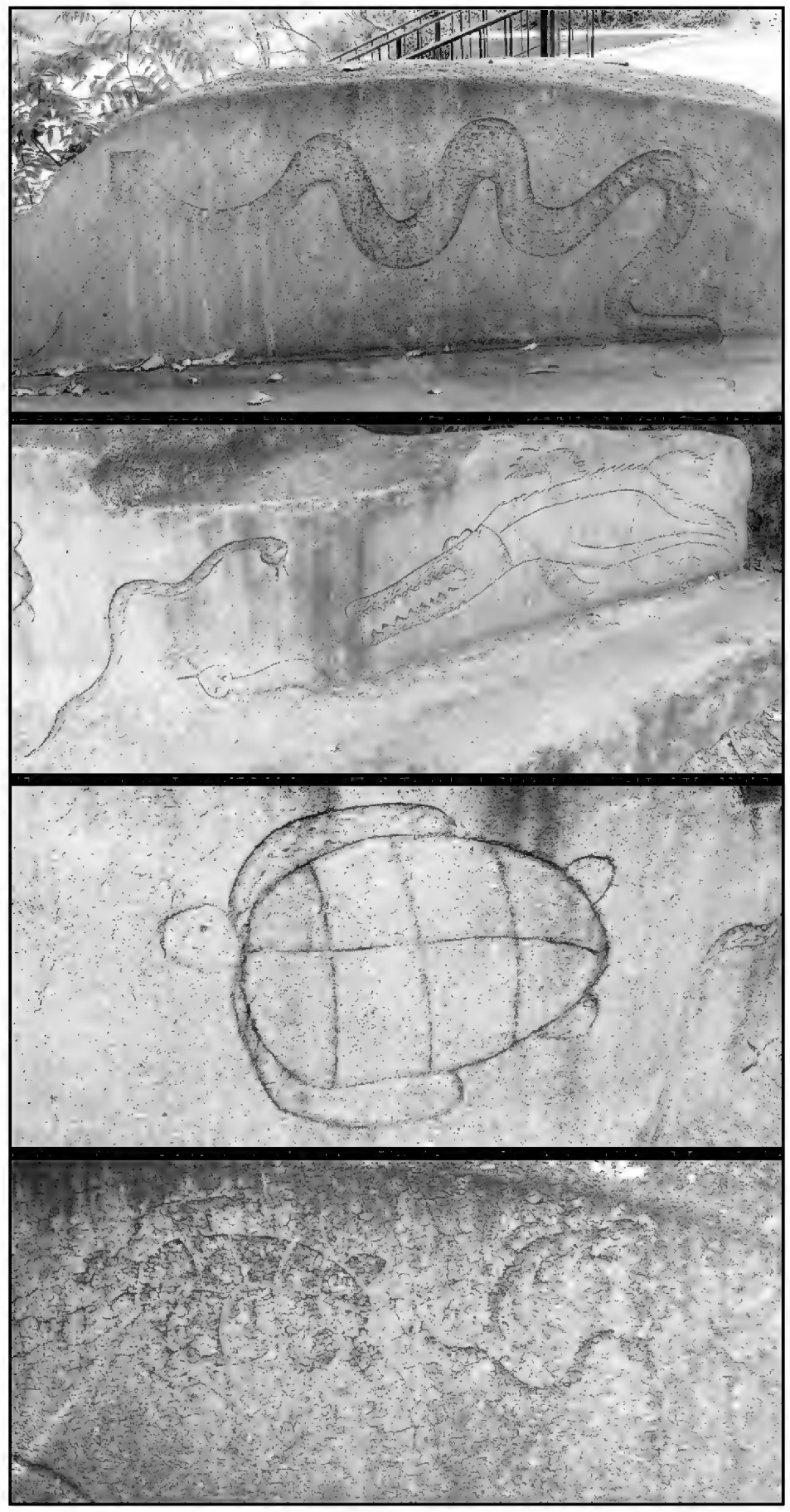

Figure 7.

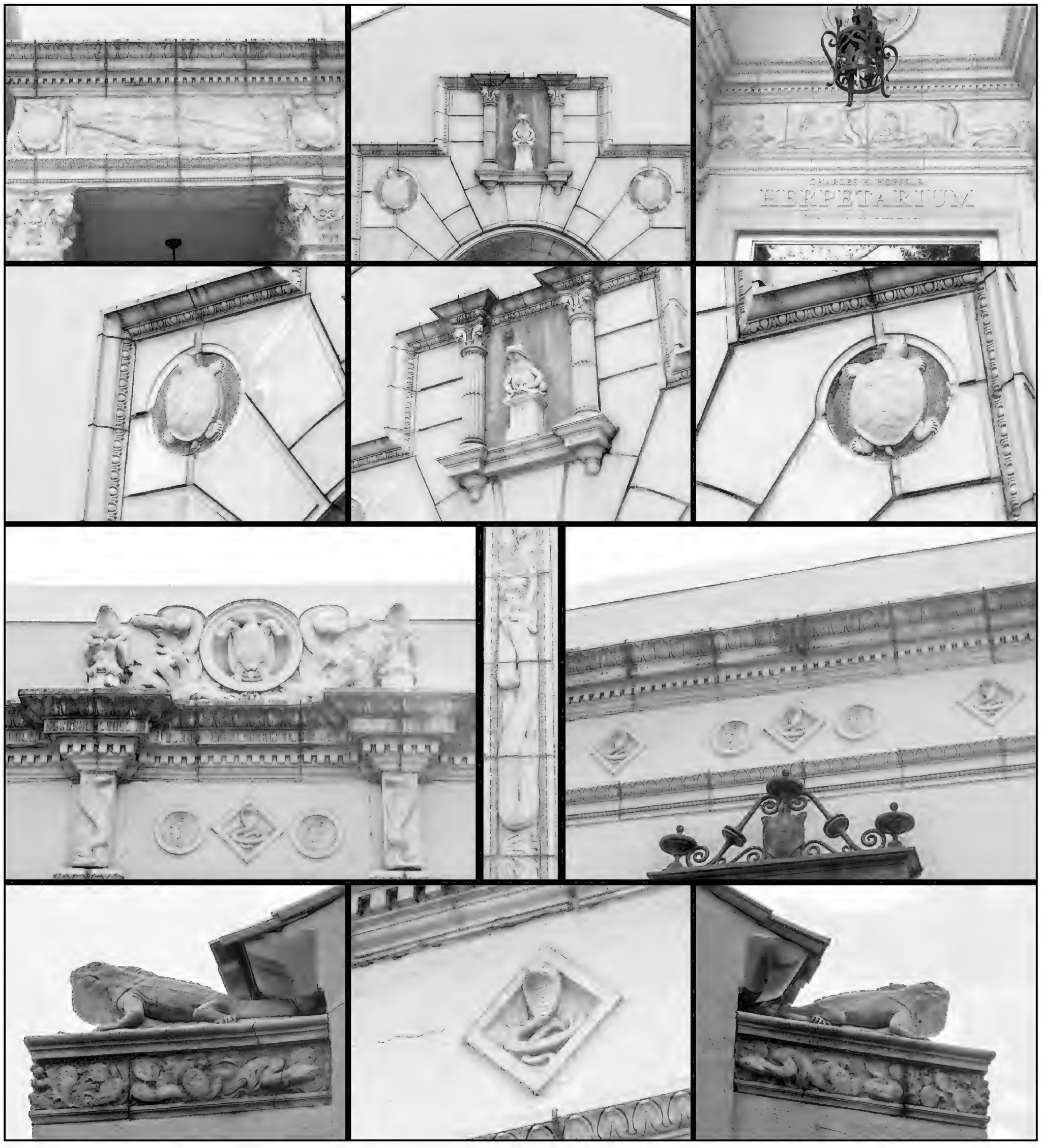

Figure 8.

Right inside the main entrance are some exhibits recessed into the floor with metal railings around them (Figure 9). There are 12 sets of the railings around these recessed displays. At the end of each section of railing are images of lizards that probably represent iguanas (Figure 10), there are images of two snakes that represent rattlesnakes of some kind (Figure 11), and in the center of each railing is an image of a turtle (Figure 12). On the top railings are ten sets of some kind of chameleons facing each other.

Near the Hellbender display is a life-size statue of a Hellbender (*Cryptobranchus* sp.) (Figure 13). This statue is probably made of bronze.

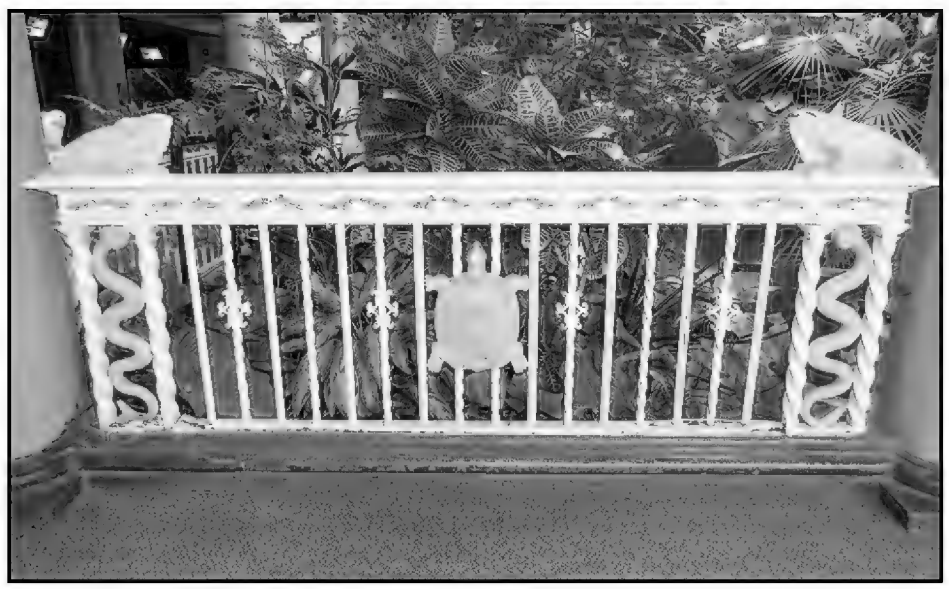

Figure 9.

Figure 10.

Figure 11.

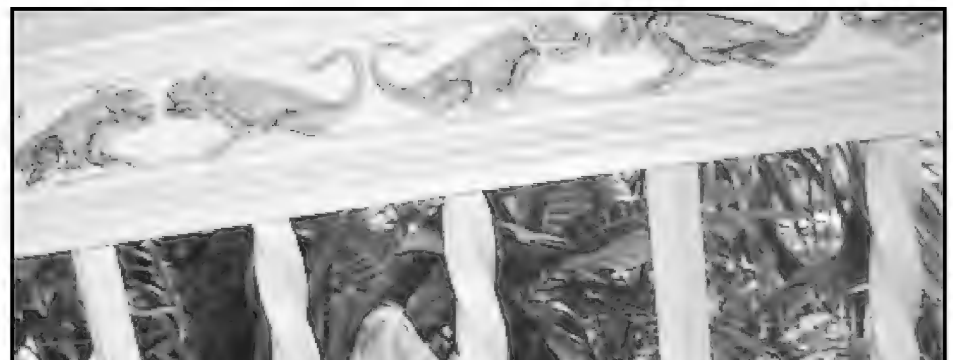

Figure 12.

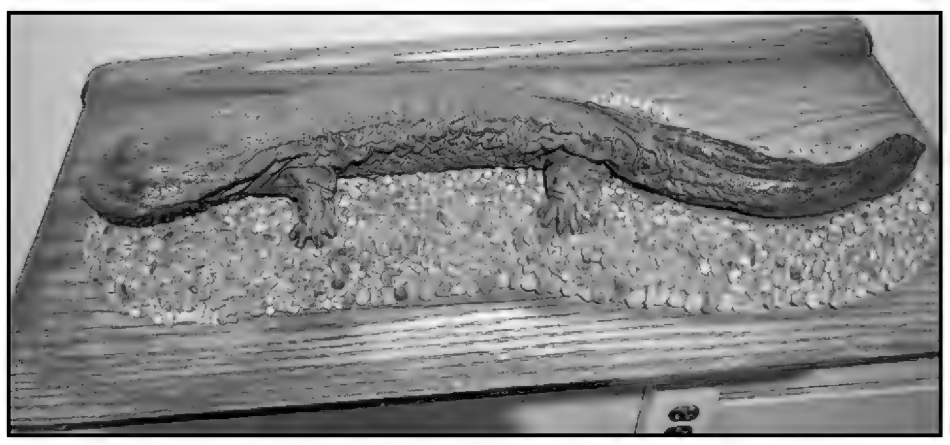

Figure 13.

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Sound or Unsound?

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As the first words to this December 2021 column are being pecked out, Thanksgiving Day is nearly upon us, which means the granddaddy of all celebrations is around the corner. Where this column is concerned, the big day will come and go before you see it. But between now and then, those little elves who prepare that which you now hold in your hands will be as busy as Santa Claus himself pulling it all together and getting it into the mail. Some of us will not get the final product until around the Martin Luther King holiday. With that being said, allow me to be the *last* person to say the words that you are by now sick of: Happy Hanukkah, Merry Christmas or Happy Holidays—whichever offends you the least. By virtue of offering a short column without any pictures, I do my best to offer those who prepare the *Bulletin* a chance to maximize their own holiday season.

With this column, I want to take us back to the year of 2005. At that time, I was hitting the field herping scene with everything I had, with no letup in sight. I was four years into a herpetological radio-telemetry project, working with Dr. Gordon Schuett, learning the mysteries of, among other things, a population of Western Diamond-backed Rattlesnakes (*Crotalus atrox*). (Yegads what an *awful* choo-choo train of words used to describe a type of rattlesnake! Thank you SSAR! I will simply call them *atrox* from here to finish). I was also heavily involved with the Tucson Herpetological Society (THS). At that point in time, the THS was still a happening group, and the future looked very bright for us. I attended every meeting for a very long stretch of time. The meetings were held on the third Tuesday of every month. On the Friday before that Tuesday, I would email a meeting reminder out to all THS members. These meeting reminders were a two-part process. The first was entitled "Business." That section of the email was a formal reminder of who was speaking, the title of the presentation, and the time and location. There was always a pre-meeting gathering as well, and the time and location of that was also noted.

Once the business part of the email was deemed complete, I would break into the second part. That went under the heading of "Monkey Business." As the title implied, that section of the email could best be described as "anything goes!" I would just let 'er rip, and I do believe that some of the best writing ever to come from these fingertips appeared in the Monkey Business portions of these emails. The responses were numerous, and highly favorable. The sad part is that most of these ravings disappeared into the void of cyberspace, and are irretrievably lost. But I managed to save a few in a Word file, and I have only recently found that file. One of the better ones that I *did* have the wisdom to save occurred in March 2005. This one was a goldmine in terms of the responses that it received. There were cries of "bullshit" from the flatlanders among us—of which I am one—and a shitstorm of physiologically-oriented papers and support from the academic crowd. I want to quickly add that I have abridged the original wording somewhat. They're my words, and hence, I get to do that! But the discussion at that *atrox* den went *exactly* as recorded. Mom was freaking out!

So, without any further pontification, let's jump right into the Monkey Business email that was sent on 11 March 2005. Pretend that you are a bunch of bored herpetologists—which is probably not a stretch—and you get *this* dandy of an email. What would your reaction to this info be?

Monkey Business

A series of events transpired three days ago. Said events set up an acquisition of knowledge about an important physiological aspect of snakes. This new-found knowledge will soon be shared with you all—but not without making you endure a long story first. The loss of yet another big chunk of personal ophidian ignorance began at a diamondback den. I was with four people, two of whom were of such caliber that the mere mention of their names would cause mass suicides amongst the readership, such would your envy be.

Yup—I was walking in tall cotton last Tuesday. The gang of four accompanying me, (whose identities I protect), consisted of a husband, a wife, and their two young sons.

We approach a massive gneiss boulder that is roughly two meters tall by four meters wide by six meters long. The length of the boulder follows the aspect of a hill, which is steep enough that if one stands upright facing it, the terrain is six inches from one's nose. Whilst poised on the west side of the boulder, Mr. Wideawake here notes that there is a small *atrox* wedged into a crevice at the bottom edge of the boulder. Everybody oohs and aahs awhile, and all take turns belly-flopping into the tall turf to get a better look at the find.

As soon as the snake has been thusly admired, an explosive "woosh" erupts, quickly followed by the roar of large keratin segments colliding together, piercing the serenity of the otherwise peaceful moment. Seeking the source of the rattling leads to a four-foot long *atrox*, which is rearing from out of the depths of foliage that has been slightly flattened by three adults and two children belly-flopping to the ground to look at a young *atrox* in a crevice.

At this point in time, multiple things develop:

1. Two more rattles sing out and add to the music of the first. We are surrounded!

2. My adult male companion, a friend in herpetology since high school, utters: "Did you hear that? These two heard the first one rattle, and are responding to it!"

3. I grab the first snake to rattle with my *wimpy* cheap-ass plastic snake tongs, and he promptly thrashes out of them, and begins

launching lightning-fast, knee-high strikes at my retreating legs.

4. While I'm dodging a highly alert and agitated rattlesnake, I ask my friend: "What do you mean they heard the rattle?"

5. My friend replies: "Snakes can hear stuff like this. Didn't you know that?"

6. I grab the big *atrox* again, and he thrashes out of my tongs again. "No, I didn't know that!"

7. While this discussion is developing, my friend's wife is in the midst of an epiphany. She has suddenly seen the folly of following her husband's friend into crotch-tall vegetation that is suddenly exploding with the sounds of hostile life forms. She is a good mother, who fears not for herself, but rather, for those who will someday select her nursing home. She begins to give her two young sons careful instruction as to how best survive the current situation.

8. My friend begins to give conflicting advice to his two offspring.

9. Doing their best to follow their parents' wishes, the boys eventually end up nut to butt at the narrow edge of a mini-cliff face. They don't know whether to defecate or go blind, and stand shivering in total confusion and terror whilst awaiting further instruction. They are poised in such fashion that if they tumble, they will plunge face-first six feet down and headlong into the furious flandickery developing at our feet.

10. Mother senses the danger, and begins yelling at sons for being too close to the edge of the cliff.

11. Husband defends his sons, saying that they are behaving *exactly* as instructed by their mother.

12. The snake thrashes out of my tongs for the third time. My friend tires of watching me fumble, and moves in to pin the head of the snake.

13. The wife begins voicing disapproval to her husband for the action developing in point 12.

14. I ask my friend "What's this nonsense about snakes hearing each other rattle?"

15. My friend says "Perhaps this discussion should wait for a more peaceful moment?" As his lips form around these words, he pins the head of the snake with his hook, grabs it behind the head, picks it up, and the snake widely gapes his displeasure. My friend next uses the business end of his hook to pry the half-inch-long fangs out of their organic scabbards, and begins to explain the function of them to his sons.

16. The wife begins voicing disapproval to her husband for the action developing in point 15.

17. I say "Yeah, perhaps we can talk about this snake's hearing stuff at lunch. In the meantime, you wouldn't happen to have a snake bag, would you?" The bag is produced, and snake number 1 is immersed into same. (A friend with snake bags is a friend indeed!)

18. In the meantime, there are still two more big *atrox* lurking about that need to be dealt with. With but maximum difficulty, this feat is accomplished. The boys come off their cliff, mom breathes a sigh of relief, and two old friends resume their conversation.

Moments later, as I bite into a chicken that is so raw that it lays an egg, I inquire further about this "snakes hearing each other rattle" stuff. My friend launches into great feats of pontification, resplendent with many big words, about this phenomenon. I turn my back to him as this conversation develops, in hopes that any inevitable dumb looks will not be visible. Apparently, the dumb look is so dominating that it appears on the back of my head, and I am asked to turn around for the explanation of how the hearing devices (also known as "ears"), work with snakes.

After much forced redundancy on my teacher's part, I think I finally got the gist of it all. I have decided to put the lesson to music, as simple ditties such as this one often helps me to retain *and* explain a general knowledge of otherwise complex information. My ditty that explains the hearing function being apparent in snakes goes like this:

The ear bone is connected to the skull bone.
And the skull bone is connected to the brain bone.
And the brain bone is connected to the ear bone,
AND OH . . . . . Gawd what a pain!

My teacher went on to explain an experiment that he performed to check his hypothesis about snakes hearing. At one point in time, he had an *atrox* that would rattle at the slightest provocation. He performed various experiments with this snake. These eventually led to the snake being several layers of visual insulation from his antagonists. Each time that anybody would so much as snap their fingers, this snake would rattle! There would be two closed doors between the finger-snapper and the rattlesnake. Well, hell! That's interesting enough, but it's all hearsay, and I have only the word of my friend to believe. I *will* say that he was so earnest in his reporting this that I did some deep thinking to determine if it *could* be true.

So, let's say he *is* telling the truth. If so, he actually had an *atrox* who could hear airborne sounds! Let's go deep with the aura and mystery of this particular *atrox*. Could it possibly be that this was that *one snake* who was born blessed with the gift of hearing? Yeah! Mother Nature herself sent him to this planet to revolutionize and evolutionize populations of *Crotalus atrox* throughout the American Southwest. He was sent here to spread his seed and help the deaf to hear. Within the blink of an eye—a few measly eons—every *atrox* in the land would hear the insects buzz and the birdies sing. And maybe a few eons later, they would develop vocal cords and start talking to each other—and maybe even start vocalizing their grievances to us humans? But then, just to wreck it all, some idiot herper came along, snagged him, and plopped him into a cage. That sounds about right to me—herper intervention is nothing new to nature. No wonder the poor guy rattled at the snap of the fingers! He was frustrated as hell, and held hostage from his noble purpose. Yeah! That would explain it!

Okay, it is at this point that we leap forward to the last month of 2021 with this column. The original email of 2005 included a preposterous experiment that was entirely a figment of my

imagination. It was probably funny enough, but it was all so ludicrous that it doesn't belong in this publication. As one who is willing to attribute just about *anything* to our buzzworm friends, I seriously do not believe the notion that rattlesnakes can hear airborne sounds. This despite the fact that folk way more knowledgeable than me earnestly believe otherwise. I spent all of my life learning that snakes did not hear airborne sound, but were capable of sensing vibrations in the ground. I am personally tired of learning and unlearning stuff at the whims of science. Once science started lumping birds into the reptile family, I lost *all* faith. I will state two reasons why I don't believe they have ears that work the way ours do.

Reason number one centers on the actual need for functional ears. They are already equipped with a combined sense of taste / smell that guides them with laser-like accuracy everywhere they go and everything they do. Additionally, they have heat-seeking pits that further enhances their ability to distinguish a food item from a predator. The only possible advantage to hearing airborne sounds might be to hear trouble approaching them. While this makes sense, everything I have seen and experienced with rattlesnakes leads me to reason number two for my disbelief:

Reason number two is *if* they are hearing airborne sounds, why are they acting so stupid as a result? It would take both hands to count the number of times that rattlesnakes have crawled directly into our camp. We are in the midst of drunken revelry when it happens, shouting insults at each other, laughing too loud, stumbling about seeking places to urinate—you name it! *Why* would a snake who could hear such things come blundering into camp? And wait—there's more! For a over year after I first heard of this snakes hearing airborne sound stuff, I would approach coiled rattlesnakes of all manner, snapping my fingers and sometimes hollering at them, and never got so much as a flinch for a response. ***Eye remain dubious*!**

And so, dear friends in herpetology, lend me your ears. For the first 50+ years of my life, I functioned under the notion that snakes are deaf to airborne sounds. For a while after this email went out, and I got pounded with papers written by those who think that birds are reptiles, I was leaning the other way. But now I'm putting my foot down. The snakes have a better chance at reading my lips than hearing my words when I quote a recent president: "Read my lips. No! No! No!" You can all believe what you want, because it's still a free country. Our editor *loves* to receive comments regarding anything that he publishes. If the reader feels he or she *must* rebut, be my guest! We'd *love* to "hear" from you.

This hear is Roger Repp, signing off from Southern Arizona, where the turtles are strong, the snakes are handsome, and the lizards are above average.

Bulletin of the Chicago Herpetological Society 56(12):231-235, 2021

Herpetology 2021

In this column the editorial staff presents short abstracts of herpetological articles we have found of interest. This is not an attempt to summarize all of the research papers being published; it is an attempt to increase the reader's awareness of what herpetologists have been doing and publishing. The editor assumes full responsibility for any errors or misleading statements.

PREDATOR–PREY REUNION

J. R. Marchetti and K. H. Beard [2021, Ichthyology and Herpetology 109(3):791-795] note that when non-native species are introduced to new areas without their native predators, they may lose their ability to detect and avoid those predators, especially if the behaviors impose some sort of cost. Few studies have investigated whether non-native populations have lost the ability to avoid their native predators. Coquí frogs, which are endemic to Puerto Rico, were introduced to Hawaii in the late 1980s. The authors' goal was to investigate whether coquís from Hawaii avoid predators from their native Puerto Rico. To test this, they collected frogs from both ranges and two arthropod predators from Puerto Rico (tailless whip scorpions and tarantulas). They determined experimentally whether frogs from Hawaii and Puerto Rico exhibited the same avoidance behaviors to these predators. It was found that frogs from both ranges avoid attack by moving away from predators and that there was no difference in behaviors between the two ranges. Results suggest that, after nearly 20 generations, frogs from Hawaii have not lost their ability to detect and avoid native predators. The antipredator behaviors coquís exhibit may help them avoid novel predators in their introduced range and may have contributed to their successful invasion.

A CASE OF MISTAKEN IDENTITY

C. M. Goodman et al. [2021, Journal of Herpetology 55(1):62-69] note that nonnative species are drivers of global change, affecting biodiversity and burdening society with economic costs. Effective management of an invasion relies on the ability to make accurate predictions about the target species' spread and impact. This requires knowledge of the target species' biology, making taxonomic validation critical. Even so, external morphology is still widely used to determine the species identity of novel invaders. This study shows that a nonnative pipid frog population in Riverview, Florida, USA, initially identified as African clawed frog (*Xenopus laevis*), is a cryptic invasion of tropical clawed frog (*Xenopus tropicalis*) and the only known nonnative population of this species. The authors used DNA sequence data and osteology from high-resolution microcomputed tomography to confirm this identification. Furthermore, they conducted field surveys to delineate the population's invaded range in Florida. They detected the presence of adult *X. tropicalis* at 22 sites and larvae at a subset of 12 sites, representing an occupied area of approximately 1,630 ha. Differing body size and physiology of these two species of *Xenopus* suggest considerable differences in their impact, spread, and potential geographic range.

DECLINE OF A FLAGSHIP SPECIES

J. G. Guerrero de la Paz et al. [2020, Herpetozoa 33:177-183] note that Mexico is home to 18 species of salamanders in the family Ambystomidae. Endangered *Ambystoma altamirani* Dugès, 1895 is a flagship species for the Lagos de Zempoala National Park (LZNP) in central Mexico, a protected area subject to numerous anthropogenic threats. *Ambystoma altamirani* populations in the park have been little studied. In 2016–2017, the authors surveyed four streams where populations of the species had been previously reported. Habitat variables did not differ amongst streams. Three had invasive rainbow trout. They were only able to locate one *A. altamirani* population in Quila, a small, cold-water stream lacking fish. They captured an average of 88 individuals (total n = 354; range 53–109) across all samples in this stream, including larvae, juveniles and adults. Population estimates ranged between 53 and 127 individuals. The absence in other streams suggests reductions in the spatial extent of *A. altamirani* in the LZNP. The authors suggest rainbow trout presence in numerous streams has led to local extirpation of *A. altamirani* and that removal and blockage of the invasive fish and a planned re-introduction strategy might help in restoring this flagship species.

MAP TURTLE NEST SITE FIDELITY

R. D. Nagle and T. J. Russell [2020, Chelonian Conservation and Biology 19(2):209-216] note that northern map turtles (*Graptemys geographica*) are a species of conservation concern with a limited distribution in Pennsylvania. The authors examined nest site fidelity of *G. geographica* along the Juniata River at Mount Union, the largest reported nesting area in the commonwealth. Nesting habitat included a mitigation area bordering a highway, partitioned by a turtle exclusion fence, and an adjacent pile of coal tailings. A linear grid along the turtle fence allowed them to determine distances between nests of individual females. The results indicate that female *G. geographica* at Mount Union exhibit nest site fidelity, as the frequency distribution of distances between nests of individual females was positively skewed, and distances between nests (both within and among seasons) were smaller than distances between randomly selected pairs of nests from different individuals. Females placed different clutches of eggs as close together as 0.30 m. Within-season (first and second clutch) internest distances were significantly smaller than internest distances among years, which increased over time. The authors also attached radio transmitters to a sample of adult females following nesting to determine the extent of riverine migrations, as long-distance nesting migrations are associated with fidelity to particular nesting sites. Following nesting, two females remained in the river near the Mount Union nesting habitat and three females moved downstream 4.3–5.6 km, yet all of the turtles returned to their previous nesting areas the following summer. Nest site fidelity can benefit map turtles if the habitat remains stable, results in high nest survivorship, and produces high-quality hatchlings, yet the behavior may be detrimental if it exposes turtles to significant risks such as road mortality or environmental contaminants. These results indicate that maintaining long-term nesting habitat and ensuring suitable river quality at Mount Union may be essential for the conservation of *G. geographica* in central Pennsylvania.

FERAL BURROS INFLUENCE DESERT TORTOISE PRESENCE

K. H. Berry et al. [2020, Herpetologica 76(3):403-413] note that across the globe, conflicting priorities exist in how land and resources are managed. In the American West, conflicts are common on public lands with historical mandates for multiple uses. The authors explored the impacts of multiple uses of land in a case study of Agassiz's desert tortoises (*Gopherus agassizii*), a federally threatened species, in the western Sonoran Desert. The tortoise has declined for many reasons, most of which relate to management of land and habitat. Frequently cited causes are livestock grazing, roads, vehicle-oriented recreation, predators, and disease. In spring of 2009, they conducted a survey to evaluate relationships between desert tortoises, vegetation associations, topography, predators, and anthropogenic uses. They sampled a 93-km^2 area with 200 independent 1-ha plots. Density (± SE) of adult tortoises was low, 2.0 ± 1.0/km^2, and the annualized death rate for adults during the 4 yr preceding the survey was high, 13.1%/yr. Tortoise sign, most of which was recent, was observed on 22% of the 200 plots, primarily in the southwestern part of the study area. More tortoise sign occurred on plots with Brittlebush (*Encelia* spp.) vegetation at higher elevations. Most plots (91.0%) had ≥1 human-related impacts: feral burro scat (*Equus asinus*; 84.0%), recent vehicle tracks and trails (34.0%), trash (28.0%), burro trails and wallows (26.5%), and old vehicle tracks (24.0%). The authors used a multimodel approach to model presence of tortoise sign on the basis of 12 predictor variables, and calculated model-averaged predictions for the probability of tortoise presence. Importance values revealed two apparent top drivers: feral burros and vegetation association. This is the first study to identify a negative association between feral burros and the presence of desert tortoises.

STRIKE-INDUCED CHEMOSENSORY SEARCHING

M. S. Teshera and R. W. Clark [2021, Herpetological Monographs 35:28-52] review the well-documented behavior of chemosensory searching in squamates with specialized tongue–vomeronasal systems. By tongue-flicking, these reptiles gather important chemical cues from their environment to guide their feeding behavior. Strike-induced chemosensory searching (SICS) is a specific expression of chemosensory reception that is central to the predatory strategy used by venomous reptiles that strike, release, and relocate their prey. This complex behavioral process consists of multiple sequential steps and has been mainly studied in viperids, particularly rattlesnakes. Although this phenomenon has been extensively researched, there is no comprehensive review of the SICS literature. The authors provide such a review, centered on the idea that SICS is a result of suppression, and then enhancement, of chemosensory searching that serves as a key element of the ambush hunting strategy that most viperid snakes use to consume large and well-defended prey. SICS is also present in other venomous and nonvenomous taxa, and a taxonomic categorization of SICS studies is included in the review. The review summarizes the key findings discovered during decades of research into this remarkable feeding behavior and highlights areas where knowledge remains incomplete in an effort to foster further research that will increase understanding of reptilian feeding ecology.

SURVIVAL IN AN ARTIFICIAL HIBERNACULUM

L. A. Bruckerhoff et al. [2021, Ichthyology and Herpetology 109(1):64-74] note that avoiding thermal stress by using hibernacula is fundamental to survival of snakes in temperate environments. Snakes may overwinter alone or aggregate in communal hibernacula to avoid temperature extremes. Limited information is available regarding the overwintering ecology of rattlesnakes, and basic demographic information is necessary for understanding population dynamics, habitat requirements, and management of rattlesnakes. Even less is known about the demographics of species and populations utilizing artificial hibernacula, which may become increasingly important as habitat is lost and/or becomes more fragmented. The authors used seven years of mark–recapture data of the western rattlesnake (*Crotalus viridis*) at an artificial hibernaculum to estimate annual apparent survival, encounter rates, and transition rates between life stages (mature vs. immature) to investigate how these rates vary over time and in response to drought conditions. They describe trends in body condition and age structure, as well as trends in the proportion of reproductive females. Apparent survival rates were consistent and high across the study period for all snakes (including immature and mature females and all males; 0.66). The probability of an immature female surviving and transitioning to a mature adult was high and consistent across the study period (0.73). The stable survival and transition rates observed in this study may indicate other demographic rates, such as reproductive output, may be important drivers of population dynamics. This study contributes basic knowledge about population dynamics of communally overwintering rattlesnakes and suggests survival rates were relatively stable for snakes regularly utilizing this artificial hibernaculum.

SPRING PEEPER SKIN BACTERIAL COMMUNITIES

K. R. Jones et al. [2021, Ichthyology and Herpetology 109(1):75-83] note that interactions between pathogens and the symbiotic microbial communities that reside in hosts can impact disease processes. Symbiotic microbial communities can act to prevent pathogen infection in some instances, while in other instances, pathogens can disrupt these symbiotic communities. The authors sought to address these interactions between the fungal skin pathogen *Batrachochytrium dendrobatidis* (Bd) and the skin bacterial communities of adult spring peepers (*Pseudacris crucifer*). In the laboratory, frogs were exposed to Bd zoospores for a 12-hour period and then monitored for five days. Bacterial community composition on the skin was assessed upon initial collection, 24 hours post-exposure, and at the conclusion of the experiment using 16S rRNA gene amplicon sequencing. Little impact on the bacterial community was observed as a result of Bd exposure, suggesting that the timeline was either too short to observe the effects of Bd, or that the skin communities are resilient in the face of such short exposure periods. In contrast, laboratory housing was associated with changes in skin bacterial community composition, in terms of both relative abundances and bacterial taxa that were present. These findings suggest that even a short time away from their natural environment can have strong effects on the composition of amphibian skin communities and that Bd exposure may not always disrupt these skin communities.

OUACHITA MAP TURTLE HATCHLING EMERGENCE

G. A. Geller et al. [2020, Chelonian Conservation and Biology 19(2):217-235] note that despite its biological importance in shaping both individual fitness and population structure, much remains to be learned about the hatchling emergence ecology of most freshwater turtles. The authors provide some of the first details on these early life stages for the Ouachita map turtle (*Graptemys ouachitensis*) obtained during 2015–2017 along the lower Wisconsin River, Iowa County, Wisconsin, and integrate the results into related research within the genus *Graptemys*. Dedicated trail cameras over in situ turtle nests provided otherwise difficult to obtain observational data relevant to natural hatchling emergence without disturbing nests or hatchlings. In contrast to some earlier reports for *Graptemys*, hatchling emergence was mostly diurnal and synchronous, primarily in the morning soon after soil temperatures began to rise from overnight low values. Data suggest a temperature change model of cueing hatchling emergence, which may represent a local or regional adaptation to reduce nocturnal predation risks, mostly from raccoons (*Procyon lotor*), or may simply reflect default diurnal hatchling activity patterns when not affected by thermal constraints. Aside from predation, hatchlings on this small study site are affected by vegetative shading, leading to relatively long times to first emergence periods (mean, 82.3 d), low mean nest temperatures (25.9°C), and a likely male-biased sex ratio. These findings highlight the value of hatchling emergence studies in revealing important influences on population viability and in guiding appropriate habitat management in conservation efforts.

CROSSING LYDEKKER'S LINE

B. R. Karin et al. [2020, Herpetologica 76(3):344-350] note that Wallace's and Lydekker's Lines both describe important biogeographic barriers in the Indo-Australian Archipelago, with Wallace's Line demarcating the boundary of the Greater Sunda Shelf and Lydekker's Line indicating the edge of the Sahul continental shelf. Despite their similarities, Wallace's Line has been much more heavily studied than has Lydekker's Line; yet the latter provides an interesting system for testing the source of fauna into eastern Wallacea. New collections of northern water dragons, *Tropicagama temporalis*, from several islands in Maluku, eastern Indonesia now allow for an assessment of the phylogeography of the species and the ability to test if New Guinean or Australian populations served as the source for overwater dispersal across Lydekker's Line into Maluku. The authors collected specimens from remote islands in eastern Indonesia, sequenced the mitochondrial ND2 gene, and aligned the data to previously sequenced specimens on GenBank. They conducted several phylogenetic and divergence time analyses to investigate the source population and timing of dispersal. They found low genetic diversity among the islands in Maluku, and these samples showed little genetic divergence from New Guinea samples. The New Guinea and Maluku populations diverged less than 1 million years ago (Ma) and together diverged from the Australian population between 2.3 and 4.7 Ma. These results, along with patterns in other taxa, illustrate that, despite Australia's close geographic proximity to many of the islands in southeastern Indonesia, New Guinea has been the more frequent source of Wallacean fauna from Sahul.

NESTING ECOLOGY OF GHARIALS

B. Khadka et al. [2020, Herpetologica 76(3):297-303] studied nesting and reproductive ecology of critically endangered gharials (*Gavialis gangeticus*) in the Narayani and Rapti rivers as well as ex situ breeding facilities in the Chitwan National Park in Nepal from 2001 to 2017. They found 151 gharial nests over 17 yr in sand banks along the Narayani (n = 94 nests) and Rapti (n = 57 nests) rivers and brought these nests to ex situ breeding facilities where eggs were artificially incubated. The number of nests (mean, 8.9/yr) showed an increasing trend over the years between 2001 and 2017. Nesting occurred within a narrow window of time (mean oviposition date, March 31) with onset of nesting varying by a maximum of 7 d between years (22–29 March). Similarly, eggs hatched from the first week of June through the first week of July (mean, June 15) after a mean incubation period of 76 d, with varying hatching success (mean, 60.5%). No correlation was found between incubation period and hatching success. Mean oviposition and hatching date both differed significantly among years probably due to annual variation in nesting cues. A significant positive correlation was found between clutch size and proportion of infertile eggs. Mean clutch size (32.3) and proportion of infertile eggs (mean, 10 eggs) both were significantly higher in clutches in Narayani than in Rapti; however, hatching success was significantly higher in clutches in Rapti. On average, nests had a circumference of 102.3 cm and a depth of 48.5 cm. Mean midriver depth (2.21 m) did not vary over the years but was higher in Narayani than in Rapti; however, mean depth of water nearest to the nest (1.15 m) varied among years and was higher in Rapti. Nests in Narayani were farther from the water's edge than nests in Rapti, suggesting local adaption of female gharials to prevent flooding of nests owing to severe flooding in the Narayani. This is the first study to present long-term scientific information on nesting and reproduction of gharials in Nepal. Such information will be pivotal in designing and implementing conservation programs as well as optimizing ex situ breeding practices for gharials in Nepal.

USEFUL ROADKILL

S. Hoefer et al. [2021, Ichthyology and Herpetology 109(3):685-690] note that there is very little information of the foraging ecology and parasite infections of many snake species. The authors used opportunistically collected roadkill to assess diet and parasite prevalence in two snake species in the Bahamas, the Bahamian racer (*Cubophis vudii vudii*) and the Bahamian boa (*Chilabothrus strigilatus strigilatus*). Over eight months, they conducted up to four daily routine road surveys along a 10 km stretch of highway, as well as opportunistic surveys elsewhere on the island of Eleuthera. Overall, they collected 270 roadkilled snakes of which less than half (39%) were intact and suitable for analyses. Lizards were the most prevalent prey items, although rodents and other snakes were also found. The study reports new prey items for the Bahamian Racer, including two snakes and a case of oophagy. Endoparasites, which appeared to be all nematodes, were present only in Bahamian racers, with 74% of all individuals infected. Parasite infection rates and loads were higher in females than in males. This study shows that using roadkilled snakes is an effective method for studying the diet and endoparasite prevalence in snakes on a Bahamian island.

REPTILES IN AGRICULTURAL HABITATS

K. Kazes et al. [2020, Herpetologica 76(3):414-422] note that agriculture poses a threat to wildlife worldwide and particularly to reptiles. However, the effects of many crop types on reptile diversity remain unknown. In this field study, the authors examined the local effects of two understudied common crop types in Mediterranean regions, intensively cultivated vineyards and intensified-traditional olive plantations, on reptile diversity patterns. They compared measurements of diversity among an array of study plots representing each crop as well as plots in adjacent patches of natural habitat. They developed a new index, the Average Specialization Index, in order to compare the degree of habitat-specialization of the species in the different habitats. Among the habitat types examined, the natural patches were the most structurally heterogeneous and contained the greatest species richness and diversity. In contrast, the intensive vineyards were structurally homogeneous and were uninhabitable areas for reptiles. The more-traditionally cultivated olive plantations were intermediately heterogeneous and provided a unique habitat occupied by a community with a high proportion of reptile species considered to be habitat specialists. Despite showing high abundance and uniformity, the reptile community within the olive plantations still contained a lower species richness and diversity compared to natural patches. In light of these results, the authors recommend implementing a more wildlife-friendly management strategy in landscapes converted to agricultural cultivation.

EFFECTS OF HUMIDITY ON TERRESTRIAL EGGS

K. González et al. [2021, Ichthyology and Herpetology 109(1):21-30] note that climate change is affecting rainfall patterns and increasing dry spells in the tropics. Although many environmental conditions can affect the hatching timing and survival of amphibian embryos, increased variation in rainfall and humidity can have particularly strong effects on species facing higher risk from dehydration, such as those with terrestrial eggs. Thus, it is important to understand how these environmental changes may affect the development, behavior, and immediate and long-term survival of amphibian embryos. The authors investigated whether embryos of gliding treefrogs (*Agalychnis spurrelli*) adaptively shift their hatching timing in response to dehydration risk, at the cost of smaller hatchling size. They raised embryos under three humidity levels and assessed egg and clutch hydration, hatching timing, and egg mortality. Mean humidity of 92% in Experiment I led to over 98% egg mortality by dehydration. A decrease from over 99 to 96% mean relative humidity in Experiment II induced premature hatching and reduced hatchling size across ages. Both clutch thickness and egg size increased at 99% and decreased at 96% humidity. The results suggest that embryos of *A. spurrelli* are extremely dependent on consistent precipitation and particularly vulnerable to climate change. Although differences in hatchling fitness were not directly measured, these results and previous findings suggest that small, premature hatchlings of *A. spurrelli* from dehydrated eggs would suffer higher mortality as tadpoles, thus embryos' self-defense against dehydration likely carries a delayed cost. These findings add to our understanding of how predicted climate changes may impact anuran early life stages.

"SECRETIVE" BEHAVIOR OF EASTERN SPADEFOOTS

A. Devan-Song et al. [2021, Journal of Herpetology 55(2): 137-150] note that despite a 1944 publication questioning the misconception that eastern spadefoots (*Scaphiopus holbrookii*) and other Scaphiopodidae are "secretive" outside of rain-induced migration and breeding aggregations, confirmation bias has perpetuated this fallacy. As a result, *S. holbrookii* is one of the least studied frogs in the United States. Amassing a large postmetamorphic dataset, the authors examined the misconception that *S. holbrookii* are secretive outside of breeding aggregates or optimal environmental conditions. Using eyeshine spotlighting, they conducted transect, mark–recapture, and haphazard spotlighting surveys in Virginia and Rhode Island forests. Although no breeding events or migration occurred during this study, they detected thousands of postmetamorphic *S. holbrookii* in Virginia and dozens in Rhode Island, the majority of which were subadults—a demographic category severely overlooked in the literature. These results are in direct contradiction with historical surveys of our sites. Spotlighting was an efficient method of detecting *S. holbrookii* eyeshine in forests, which were easily differentiated from arthropod eyeshine. Minimal effort was needed to detect the presence of *S. holbrookii* in Virginia and Rhode Island, even though the states have different climates and *S. holbrookii* densities. They also discovered a previously undetected population in Rhode Island. *Scaphiopus holbrookii* of all postmetamorphic size classes emerged regularly from burrows, even with no precipitation. The authors discuss how confirmation bias and lack of appropriate field methods for nonbreeding life history stages has fueled the misconception that *S. holbrookii* are difficult to find outside of optimal weather conditions, which has hindered progress studying the ecology and conservation of this species.

EARLY BIRTHS IN MONTANE RATTLESNAKE SPECIES

D. B. Prival et al. [2021, Journal of Herpetology 55(3):292-297] note that a warming climate is correlated with phenological shifts in many taxa. They analyzed data from two long-term field studies of three viviparous viperid snakes to examine correlations between temperature and parturition dates. They studied rock rattlesnakes (*Crotalus lepidus*) and ridge-nosed rattlesnakes (*Crotalus willardi*) over a 31-yr period and twin-spotted rattlesnakes (*Crotalus pricei*) over a 23-yr period. On average, a 1 °C increase in mean daily maximum temperature during mid-April to June, the probable gestation period, was associated with *C. lepidus* litters being found 6.0 ± 0.84 days earlier and *C. willardi* litters being found 5.7 ± 1.79 days earlier. The authors were more likely to find *C. pricei* neonates during surveys in late July following warm springs and pregnant females in late July following cool springs. Although earlier parturitions could potentially increase maternal survival and improve lifetime reproductive output, warmer temperatures during embryo development could cause unviability or neonate abnormalities. Neonate survival would probably be negatively affected if births occurred before the onset of the summer monsoon rains. Populations of these species that inhabit the highest elevations of mountain ranges will be unable to shift their distributions to maintain the thermal conditions under which they evolved.

NATURAL HISTORY OF RUSSELL'S VIPERS

X. Glaudas [2021, Journal of Herpetology 55(1):151-159] notes that venomous snakes are a public health concern in India, where they kill tens of thousands of people annually. Russell's vipers are the major culprit, but despite their clinical significance, there is virtually no information on their ecology. The author used radiotelemetry for a 9-mo period to study the spatial and behavioral ecology of a population of Russell's vipers (*Daboia russelii*) in a human-dominated rural landscape in Karnataka, India. Russell's vipers spent a substantial amount of time in plantations, which make up a significant proportion of the landscape. Snakes were the least active in March, a dry month with the hottest monthly mean maximum temperatures recorded; and spatial activity comparatively increased in late fall-early winter and May, corresponding with the timing of mating activities and the end of the dry season, respectively. Russell's vipers basked throughout the year, but basking behavior was more frequent in January and February, when the monthly mean minimum temperatures were the lowest. The probability of observing a snake basking increased with decreasing minimum temperatures. Similarly, the snakes were found in ambush foraging postures during daytime throughout the year, and the odds of observing diurnal foraging increased with increasing minimum temperatures and was affected by an interaction between maximum temperature and sex. Overall, the data indicate that this tropical viper actively thermoregulates and is to some extent diurnal. This study provides the first quantitative field-based natural history information on Russell's vipers, one of the most medically important snakes in the world.

NEW DATA FROM OLD SPECIMENS

S. Ruane [2021, Ichthyology and Herpetology 109(2):392-396] notes that museums provide a wealth of scientific information via preserved natural history specimens, including but not limited to dietary, morphological, and geographic distributions of organisms. In the modern molecular age, however, fluid-preserved museum collections have not always been at the frontline for generating useable data, despite the fact that for some species, only museum specimens are known, with no fresh genetic materials available. We are now at a major shift in our ability to use museum specimens for molecular phylogenetics, where modern subgenomic sequencing techniques better allow for successfully sequencing hundreds to thousands of phylogenetically informative loci for historical specimens, including formalin- and fluid-preserved amphibians and reptiles. The author reviews the current state of the field, with respect to studies which have successfully generated high-throughput molecular datasets using fluid-preserved specimens for herpetofauna, particularly for systematic studies. Although only six publications fitting the search criteria were found, these studies provide a wealth of knowledge on the uses of museum herpetological specimens for modern work and illustrate just how important historical specimens are for enhancing our current understanding of species genetic structure, phylogenetic placements, and for disentangling taxonomic conundrums. In an age where both museums and general collecting come under critique from the general public, this review emphasizes the continued importance of museum specimens across all subfields in the study of amphibians and reptiles.

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Minutes of the CHS Board Meeting, November 12, 2021

A virtual meeting of the CHS board of directors via Zoom conference video/call was called to order at 7:45 P.M. Board members Rachel Bladow, Stephanie Dochterman, John Gutierrez, Kyle Houlihan and Margaret Ann Paauw were absent. A quorum was not present. No nonmembers of the board were in attendance. Minutes of the October 15 board meeting were read.

Officers' reports

Treasurer: Rich Crowley went over the October financial report. Mike Dloogatch moved to reimburse Rich Crowley in the amount of $1200 for expenses he has incurred since February 2021 in connection with the DuPage County Animal Control confiscation. The motion was circulated via email and passed with seven voting in favor.

Membership secretary: Mike Dloogatch read the list of those whose memberships have expired, and reported a small increase in membership this month.

Sergeant-at-arms: Tom Mikosz reported that the October 27 hybrid meeting (in person and via zoom webinar) was attended in person by 19 people.

Committee reports

Junior Herpers: John Archer reported that a couple of people at the general meeting expressed an interest in running the Junior Herpers. John will get in touch with those people.

Library: Joan Moore is stepping down as chairperson.

Old business

Fundraising through the Rockford Charitable Games needs more research on the legal aspects.

Elections for the 2022 CHS board of directors will be held online.

Allison from the Notebaert Museum has expressed interest in working with us on citizen science projects.

New business

A lot of positive feedback from the in-person meeting; even signed up a new member.

The meeting adjourned at 8:33 P.M.

Respectfully submitted by recording secretary Gail Oomens

NEW CHS MEMBERS THIS MONTH

Sarah H. Mohr
Brett Seibert
Bill Stewart

Advertisements

For sale: **highest quality frozen rodents**. I have been raising rodents for over 30 years and can supply you with the highest quality mice available in the U.S. These are always exceptionally clean and healthy with no urine odor or mixed in bedding. I feed these to my own reptile collection exclusively and so make sure they are the best available. All rodents are produced from my personal breeding colony and are fed exceptional high protein, low fat rodent diets; no dog food is ever used. Additionally, all mice are flash frozen and are separate in the bag, not frozen together. I also have ultra low shipping prices to most areas of the U.S. and can beat others shipping prices considerably. I specialize in the smaller mice sizes and currently have the following four sizes available: Small pink mice (1 day old—1 gm) , $25 /100; Large pink mice (4 to 5 days old—2 to 3 gm), $27.50 /100; Small fuzzy mice (7 to 8 days old—5 to 6 gm), $30/100; Large fuzzy mice / hoppers (10 to 12 days old—8 to 10 gm), $35/100 Contact Kelly Haller at 785-224-7291 or by e-mail at kelhal56@hotmail.com

Line ads in this publication are run free for CHS members—$2 per line for nonmembers. Any ad may be refused at the discretion of the Editor. Submit ads to mdloogatch@chicagoherp.org.

UPCOMING MEETINGS

The Chicago Herpetological Society will not hold a general meeting in December 2021.

Please try to join us *in person* for the next meeting of the Chicago Herpetological Society, to be held at 7:30 P.M., Wednesday, January 26, 2022, at the Peggy Notebaert Nature Museum, Cannon Drive and Fullerton Parkway, in Chicago. **Masks will be required for all attendees.**

Board of Directors Meeting

Are you interested in how the decisions are made that determine how the Chicago Herpetological Society runs? And would you like to have input into those decisions? The next board meeting will be held online. If you wish to take part, please email: mdloogatch@chicagoherp.org.

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